CONNECTION BETWEEN GLOBAL CONSERVATION STATUS, GEOGRAPHICAL RANGE SIZE, MIDPOINT LATITUDE, FEMALE CARAPACE LENGTH, AND CLUTCH SIZE OF TESTUDINES

by

Ian E. Wick

Source: Wick 2012

FACULTY OF NATURAL RESOURCES MANAGEMENT
LAKEHEAD UNIVERSITY
THUNDER BAY, ONTARIO

April 21, 2020

CONNECTION BETWEEN GLOBAL CONSERVATION STATUS, GEOGRAPHICAL RANGE SIZE, MIDPOINT LATITUDE, FEMALE CARAPACE LENGTH, AND CLUTCH SIZE OF TESTUDINES

by

Ian E. Wick

An Undergraduate Thesis Submitted in
Partial Fulfillment of the Requirements for the
Degree of Honours Bachelor of Environmental Management

Faculty of Natural Resources Management

Lakehead University

April 21, 2020

Major Advisor	Second Reader
Dr. Stephen J. Hecnar	Dr. William Wilson

LIBRARY RIGHTS STATEMENT

Signature:

Date: April 21, 2020

A CAUTION TO THE READER

This HBEM thesis has been through a semi-formal process of review and comment by at least two faculty members. It is made available for loan by the Faculty of Natural Resources Management for the purpose of advancing the practice of professional and scientific forestry.

The reader should aware that opinions and conclusions expressed in this document are those of the student and do not necessarily reflect the opinions of the thesis supervisor, the faculty or Lakehead University.

ABSTRACT

Wick, Ian E. 2020. Connection between global conservation status, geographical range size, midpoint latitude, female carapace length, and clutch size of Testudines.

Keywords: Carapace, clutch, conservation, distribution, family, habitat loss, IUCN, latitude, range, road mortality, status, Testudines, turtle

The need for species conservation is only magnified with each passing day. Testudines are one of the taxonomic orders most at risk of extinction on Earth. Over 70% of Testudines are globally listed on the IUCN Red List and over 60% of those are at risk of extinction. Testudines face many threats including habitat loss and degradation. At time of data collection there were 258 turtles globally listed on the IUCN Red List. Following justified additions there were recognized to be 266 turtle species globally listed on the IUCN Red List for the purpose of this study. I collected data for 357 turtle species and examined the association of conservation status with geographic range size, midpoint latitude, female carapace length, and clutch size to determine if any of these attributes would be useful for determining extinction risk. IUCN status rank for species was most highly correlated with mean female carapace length. IUCN status rank for species was most highly correlated with mean female carapace length. The positive association of risk with increasing body size supports concerns about the impact of harvesting or poaching of turtles and tortoises by humans. Testudines are clearly in need of conservation efforts.

CONTENTS

TABLES

FIGURES

ACKNOWLEDGEMENTS

This study though was by no means an individual effort. It was made possible by several humans, not all of which I can thank in here. I had the opportunity to take Herpetology here at Lakehead University with Dr. Hecnar and I would have to say it was one of my favourite classes, if not my favourite. Dr. Hecnar has provided guidance throughout this process beginning far before this study even took place. It was Dr. Hecnar that led me towards this study by suggesting I examine the IUCN status of Testudines. Dr. Hecnar was always available and offered helpful resources while providing helpful suggestions and edits throughout. It is always a pleasure to sit down and have a discussion with Dr. Hecnar. It would have been next to impossible to analyze the data and complete the results without Dr. Hecnar. Dr. Hecnar claims not to be a statistician but could have fooled me. I am very thankful to Dr. Hecnar for being my thesis supervisor and offering support and advise throughout the entire process of completing this thesis.

I would also like to thank Lakehead University and my second reader, Dr. Wilson. I have had the opportunity to be in multiple classes with Dr. Wilson and his attitude is contagious. Each class would be right up there with Herpetology. It is always a pleasure to have a discussion with Dr. Wilson. He is always available to his students and has an incredible ability to evoke thought and get the best out of his students.

I would also like to thank Tija Hauta for assistance and advice throughout. Thank you too to Tija for tolerating my odd sleeping schedule at times and always entertaining my thoughts or what I perceived to be discoveries regardless of time of day or night.

My parents and family also deserve a huge thank you for always supporting my educational dreams and always being there for me from day one of my existence.

I would also like to thank the faculty of Sir Sandford Fleming College – Frost Campus. I could not imagine a better place to have started my environmental educational journey and I will be forever thankful for my time there.

INTRODUCTION

With each passing day, the importance of conservation worldwide becomes increasingly salient. As human population growth continues, pollution and resource consumption increase while the resources and habitat available for other species decreases. The resulting impact on various organisms may differ in connection with their biological attributes. It is estimated the cost of conserving biodiversity globally could be over 75 billion USD annually (McCarthy 2013). According to Rhodin *et al.* (2018), Testudines (turtles and tortoises) are one of the orders of vertebrates most at risk of extinction similar to that of Caudata (salamanders) and Primates. Currently 62.8% of Testudine species on the IUCN Red List are at risk of extinction, while 50.8% of Caudata and 59.8% of Primates listed are at risk of extinction (IUCN 2019a; IUCN 2019b; IUCN 2019c). Without conservation efforts, Testudine diversity could suffer significantly within the next century (Buhlmann *et al.* 2009). Behler (2000) stated, “there is no vertebrate group facing greater survival problems today”.

Testudines face numerous threats that vary in severity. The most serious threat to Testudines is habitat loss and fragmentation (Lesbarréres *et al.* 2014). Another major threat is poaching for both meat and medicines, and the exotic pet trade (Rhodin *et al.* 2018). The shell and bones are used for some traditional Chinese medicines and as Rhodin *et al.* (2018) notes “Asia is at the epicentre of the global turtle extinction crisis”. Road mortality is another major threat to some species of Testudines (Ashley *et al.* 2007). However, road mortality is not always accidental, as Ashley *et al.* (2007) found that 2.7 out of every 100 drivers will intentionally hit a turtle that is on the road. Other threats include climate change, pollution, infectious diseases, invasive species, and nest predation (Rhodin *et al.* 2018). Plastic pollutants found in the oceans are a major threat to Sea Turtles as they can ingest them or become entangled (Assuncao Ivar do Sul *et al.* 2010). A turtle found floating near Melbourne Beach in Florida defecated 74 foreign objects, requiring over a month to do so, following the removal of a gastrointestinal tract obstruction (Stamper *et al.* 2009). These threats are all very real and require human attention, as they are something the evolution of the nomadic turtle home more often referred to as the shell cannot protect them against. As Rhodin *et al.* (2011) stated "turtles are in serious trouble".

The unfortunate plight facing Testudines may be further expedited via taxonomic bias. Although in terms of species richness herpetofauna comprise over 40% of terrestrial vertebrates, Christoffel and Lepczyk (2012) found they were given less than 6% of the space in six wildlife journals over the last 30 years. Library holdings of post-secondary educational institutions and reintroduction projects have also displayed taxonomic bias (Seddon *et al.* 2005; Hecnar 2009).

Testudines play important roles in the functioning of the ecosystems they inhabit (Stanford *et al.* 2018). They can act as cleaners by scavenging and eating carrion (Langley 2018). They can also act as important agents of seed dispersal or create homes for other organisms (Braun and Brooks 1987; Langley 2018). Sometimes seeds can be reliant on turtles for germination (Rhodin *et al.* 2018). The Gopher Tortoise (*Gopherus polyphemus*) is considered a keystone species, as the burrows they create are shared with over 350 other species (Florida Fish and Wildlife 2019).

Over 250 of 360 extant species of Testudines are listed on IUCN's Red List (Rhodin *et al.* 2018). The International Union for Conservation of Nature (IUCN) was established in 1964 and provides critical information regarding status of the world's biodiversity (IUCN 2019d). The Species Survival Commission (SSC) is responsible for completing Red List assessments (Campbell 2012). According to IUCN (2019d) 28,000 of the 105,700 species from all taxa listed on the Red List are threatened with extinction. In order to be considered threatened a species must be listed as "Vulnerable", "Endangered", or "Critically Endangered" (IUCN 2019e). Of the 258 currently listed Testudine species on the global IUCN Red List, 162 are at risk of extinction, 76 are described as decreasing, and only seven have a population trend described as increasing (Figure 1) (IUCN 2019f).

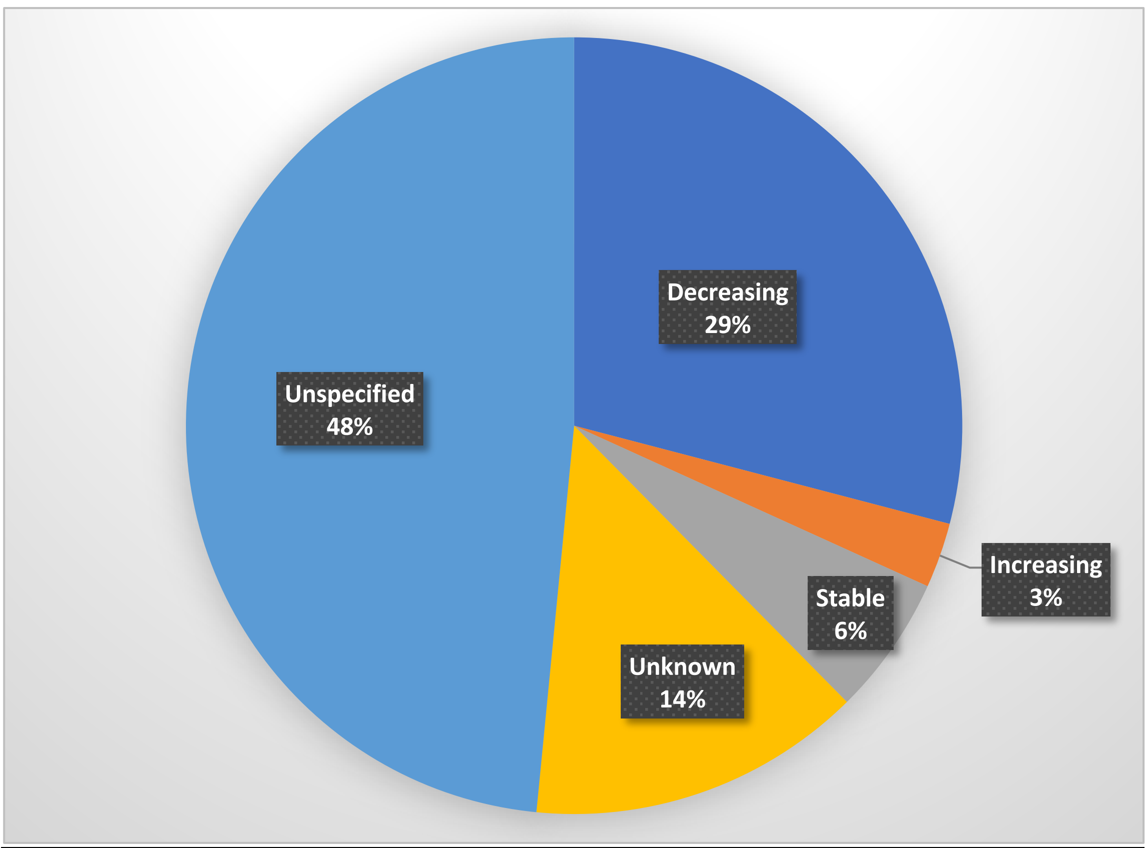

Figure 1. Population trend of the 258 Testudine species listed on the IUCN Red List (Adapted from IUCN 2019f).

LITERATURE REVIEW

The Order Testudines encompasses all the turtles and tortoises on Earth (Rhodin *et al.* 2018). Testudines can be found on land and in water, both fresh and salt, in every continent in the world excluding Antarctica (Zug 2019). All existing Testudines are considered in the suborders Pleurodira or Cryptodira, which are side-neck turtles and hidden neck turtles respectively (Pough *et al.* 2018). Some Cryptodires however lack the ability to fully retract their head into the shell, as seen in some members of the Chelydridae, Cheloniidae, and Dermochelyidae families (Pough *et al.* 2018; Boyer and Innis 2019). Pleurodires often have very long necks and are unable to retract their neck or head into their shell altogether, instead folding them sideways (Pough *et al.* 2018; Boyer and Innis 2019). There are only three families of Pleurodires as they are not as common as Cryptodires (Pough *et al.* 2018).

Understanding the connection between current conservation status and biological attributes may aid in understanding how Testudines become threatened as well as how conservation efforts can be better directed. Literature on conservation status and biological attributes of Testudines individually is abundant, however the connection between them is not often examined. Interestingly, of all extant reptiles, Testudines offer the most complete fossil record, however they are also possibly the most threatened vertebrate on earth (Lovich 2018; Pough 2018). Orentstein (2012) introduced readers to one of the earliest accounts of the devastation of turtles at the hands of humans, as the story of William Dampier and the Galapagos Islands is briefly reviewed. William Dampier is described as an “explorer and some-time pirate” and was the first to describe the tortoises of the Galapagos Islands, noting their abundance and size while also discussing the tortoises of Madagascar, the West Indies, and the Mascarenes

(Orenstein 2012). As Orenstein (2012) noted, unfortunately Dampier was not acknowledging them with admiration, respect, preservation or conservation in mind, instead merely thinking of the sustenance they could provide.

CONSERVATION

As of 2018, 14.9% of Earth's terrestrial area was protected (UNEP-WCMC *et al.* 2018). Testudines are in need of conservation as over 50% are threatened with extinction (Lovich 2018). They often have, or ideally have, what could be described as odd age structures within populations, and this is an important consideration in turtle conservation (Klemens 2000). As Klemens (2000) noted, the ideal proportion of eggs and juveniles in comparison to adults can vary greatly depending on species, however this proportion should greatly favour the eggs and juveniles. Rhodin *et al.* (2018) examined the IUCN conservation status for every extant Testudine species, while also including any recently extinct members, and noted, that ongoing evaluation of turtle species status and the efforts of the IUCN are essential components of future conservation efforts. There could be a significant reduction in turtle diversity in the near future (Buhlmann *et al.* 2009). Potential priority areas for turtle conservation and the need for conservation planning are outlined by Buhlmann *et al.* (2009) while examining tortoises and freshwater turtles. Iverson (1991) noted the importance of understanding that turtles followed a Type III survivorship curve and its importance in conservation. Rodrigues *et al.* (2006) discussed the importance and value of the IUCN Red List to conservation. In addition to designations provided by the IUCN there is useful data that can aid in conservation planning (Rodrigues *et al.* 2006). The IUCN is not without its critics though, as noted by Mrosovsky (1997), as he explored the importance of sound and open science. Campbell (2011) explored the political side of the IUCN while examining the Hawksbill Sea Turtle (*Eretmochelys imbricata*).

ATTRIBUTES

Turtles date back over 200 million years, with the oldest known fossil being that of a carapace-lacking turtle known as *Odontochelys semitestacea* (Orenstein 2012). Absence of a carapace (dorsal shell) indicates it evolved after the plastron (ventral shell) (Pough *et al.* 2018). Turtles vary in size, as Orenstein (2012) noted, the largest turtle of all time was the Cretaceous sea turtle *Archelon ischyros*, weighing up to approximately 2040 kg and measuring up to approximately 4.5 m from snout to tail. Today, the largest turtle in the world is the last remaining member of the Family Dermochelyidae, the Leatherback Sea Turtle (*Dermochelys coriacea*), with a carapace length of up to two metres (Government of Canada 2019). Likely the smallest Testudine is the endangered Speckled Dwarf Tortoise (*Chersobius signatus*), which is endemic to South Africa and has a maximum carapace length of 110 mm (Orenstein 2012; Hofmeyr *et al.* 2018).

Turtles are well known for having a shell, although the origin of this conspicuous adaptation is somewhat controversial (Scoch *et al.* 2019). The shell is comprised of the carapace and plastron, which are the top and bottom of the shell respectively. The carapace and plastron are connected on each side by what is called the bridge and inside the shell the vertebrae are fused to the carapace (Pough *et al.* 2018). Most Testudines have a bony shell, but there are three families that possess a shell covered by leathery skin (Pough *et al.* 2018). Testudines rely on their shells as a means of protection from predators (Balani *et al.* 2011). Although there were once turtles that had teeth, such as *Odontochelys semitestacea*, all extant turtles lack teeth, instead having a keratinous beak (Orenstein 2012; Pough *et al.* 2018).

Turtles are oviparous (lay eggs), and clutch size refers to the number of eggs laid at one time (Shine 1983). Clutch size is associated with maternal body size and this notion of positive correlation is supported by a substantial amount of evidence (Ford and Seigel 1989; Ashton *et al.* 2007). Shine and Iverson (1995) explored the connection between maximum body size and age of sexual maturation, finding that much like other reptiles, the majority of turtles reach sexual maturity at approximately 70% of their maximum body size. Sexual dimorphism, reproductive strategies, and the size of male and female turtles were explored by Berry and Shine (1980), finding that terrestrial and aquatic species often have differing comparable sizes between sexes. Berry and Shine (1980) found that males tend to be larger in terrestrial species and females are likely to be larger in aquatic species. Body size of Testudines is significant, not simply age, as size often determines age of maturity (Iverson 1992a). This is evident in Snapping Turtles (*Chelydra serpentina*) in Ontario, where they hibernate for multiple months annually and do not reach maturity for 15-20 years, however in Florida, where hibernation is not required, they can reach maturity in as little as four to eight years (Government of Canada 2016; Government of Ontario 2019). Therefore, clutch size is also associated with geographical location. A study by Ashton *et al.* (2007), found that mean clutch size in Gopher Tortoises (*Gopherus polyphemus*) decreased with increasing latitude. This study also found that clutch size increased with increasing productivity, was positively correlated with temperature, and negatively correlated with seasonality. Ashton *et al.* (2007) also noted that a decrease in clutch size in the largest individuals can be attributed to the senescence hypothesis. Collins and Crump (2009) suggested that low clutch sizes can be associated with population declines in amphibians.

Rhodin *et al.* (2017) provided detailed distribution maps for almost every extant member of the Testudines Order. Life histories of Testudines make populations more susceptible to threats (Gibbs and Shriver 2002). Siliceo and Diaz (2010) explored the connection between conservation status and clutch and range sizes of lacertid lizards, showing there was a connection between range size and conservation status, as well as clutch size and conservation status. Hero *et al.* (2005) explored a similar topic relating to the decline of amphibians in eastern Australia, finding that conservation status was correlated with both clutch size and geographic range and could aid in predicting a species vulnerability to extinction. According to Rapoport's rule range size increases with increasing latitude (Stevens 1989). Hecnar (1999a) provided evidence that Rapoport's rule is a local effect rather than a general rule. According to Harris and Pimm (2008) "small geographical range size is the best predictor of threat of extinction in terrestrial species".

OBJECTIVE

My objective was to determine if the global conservation status of Testudine species was associated with body size, clutch size, geographical range size, and latitude. To do so I compared IUCN conservation status of turtle species with biological attribute data of interest collected from numerous sources.

NULL HYPOTHESIS

Conservation status of Testudines is not correlated with the attribute of interest.

MATERIALS AND METHODS

I gathered information regarding the global conservation status and biological attributes of Testudines from a wide variety of sources including peer-reviewed journal articles, books, and online resources. I used the IUCN Red List to collect all available information regarding global conservation status and population trends for each listed Testudine. Rhodin *et al.* (2017) was used to complete the list of Testudines to be examined in my study. Information regarding Testudines both listed and not listed on the IUCN Red List was collected via the aforementioned resources. A table featuring data for all 357 turtle species within this study can be found in the Appendix.

I calculated midpoint latitude for all 357 turtle species within this study using maps contained within Rhodin *et al.* (2017). Midpoint was determined as the intersection of lines connecting the most northern and southern extent with the most eastern and western extent. I then used a conspicuous geographical feature, border, or recognizable point to determine the precise midpoint latitude on Google (2019).

I calculated geographical range size using maps contained within Rhodin *et al.* (2017), Iverson (1992b), with unpublished data used for maps in Hecnar (1999b). I calculated the area (km^2) of each species range using a dot grid applied to the range map (Iverson 1992b, Hecnar 1999b, or Rhodin *et al.* 2017) and determined the scale from geographic features and Google (2019).

I collected mean female carapace length and clutch size data from multiple peer-reviewed journal articles, books, and online resources. If mean clutch size or female carapace length could not be located, but a range could be, I used the midpoint of the range as the mean. For example, an estimated mean clutch size of 15.5 corresponds to the range of 6-25 for *Cyclanorbis senegalensis* (IUCN 2020). A clutch size for

Cyclanorbis elegans could not be found, so I used a published count of 27 oviductal eggs (Demaya *et al.* 2019). In the case of *Actinemys pallida* the clutch size and mean female carapace length was found using distribution maps in correlation with two journal articles. It is believed a journal article regarding *Clemmys marmorata* which offered clutch size and mean female carapace length was in fact *A. pallida*. A later journal article referenced this paper and discussed the turtle by the name *A. pallida*, therefore the information provided for *C. marmorata* was used for *A. pallida* (Lovich and Meyer 2002; Rhodin *et al.* 2017; Cummings *et al.* 2018). The clutch size and mean female carapace length within Iverson *et al.* (1993) for *Chelodina oblonga* was not used. Kennett *et al.* (2014) describes this as “a fairly large freshwater turtle”. The data contained within Iverson *et al.* (1993) for *C. oblonga* comes from Clay (1981). The map used in Clay (1981) does not match the updated geographical range of *C. oblonga* provided in Rhodin *et al.* (2017). Being that *Chelodina siebenrocki* is a synonym for *C. oblonga*, the data provided for *C. siebenrocki* was used for *C. oblonga*. In Iverson *et al.* (1993) *Chelodina novaeguineae* has a clutch size listed as 10 based on Kennett *et al.* (1992). Based on distribution maps from Rhodin *et al.* (2017), as well as the distribution map provided in Kennett *et al.* (1992) and a journal article by McCord and Thomson (2002) it is believed this was in fact the *Chelodina canni*. Therefore, the provided mean female carapace length and clutch was used for *C. canni*. The carapace lengths obtained from Powell *et al.* (2016) were not all stated as female. However, it is presumed the book showed differing lengths for males and females when there was a notable difference.

According to Rhodin *et al.* (2017) *Actinemys pallida* is listed under *Actinemys marmorata*, *Amyda ornata* is listed under *Amyda cartilaginea*, *Chrysemys dorsalis* is listed under *Chrysemys picta*, *Cuora cyclornata* is listed under *Cuora trifasciata*, *Graptemys sabinensis* is listed under *Graptemys ouachitensis*, *Kinosternon steindachneri* is listed under *Kinosternon subrubrum*, and *Pseudemys floridana* is listed under *Pseudemys concinna*. Therefore, these turtles were given the same global IUCN status and population trends for which they were listed. According to IUCN (2020a) *Chelodina colliei* is listed under *Chelodina oblonga*, therefore it was given the same global IUCN status and population trend as well. For the purpose of this study, this brings the total turtle species globally listed on the IUCN Red List from 258 to 266.

I constructed a database and did some initial analyses using Microsoft Excel. I initially tested data for normality and calculated basic descriptive statistics using Microsoft Excel and SYSTAT 13. To determine the relationship between global IUCN status and biological variables I calculated Pearson correlation coefficients using JASP and SYSTAT 13. I then conducted a Spearman's non-parametric test when transformation did not normalize data for comparison. *T*-tests were run using Microsoft Excel and SYSTAT 13. To explain the association between IUCN status and biological attribute variables I constructed complete and stepwise (forward and backward) multivariate regression models. For descriptive models and comparison, I also used Akaike Information Criterion (AIC) analyses. Regressions and AIC models were analysed using SYSTAT 13.

Pearson correlation tests were run for six differing sets of data (Table 2 and 3). The first included all turtle species with the global IUCN status given an ascending rank from one through eight (not listed = 1, not defined or data deficient = 2, least concern = 3, near threatened = 4, vulnerable = 5, endangered = 6, critically endangered = 7, and extinct in the wild or extinct = 8). The second test included the same data and was run using the same ranking system however the seven extant sea turtles were removed. For the third run, “Not Listed”, “Not Defined”, and “Data Deficient” were removed as only species with a defined conservation status and the remaining turtle species were given an ascending rank (least concern = 1, near threatened = 2, vulnerable = 3, endangered = 4, critically endangered = 5, and extinct in the wild or extinct = 6). The fourth test included the same data and ranking system as the third however the sea turtles were removed. For test five “Not Listed”, “Not Defined”, “Data Deficient”, “Extinct in the Wild”, and “Extinct” were removed, with the remaining species given an ascending rank based on conservation status (least concern = 1, near threatened = 2, vulnerable = 3, endangered = 4, and critically endangered = 5). The sixth test had the same parameters as the fifth, however sea turtles were removed.

Two-sample *t*-tests assuming unequal variances were run for four differing sets of data (Table 4). The confidence interval used for all *t*-tests was 95%. Each of the 30 *t*-tests presented within Table 4 compared means of differing attributes for four differing sets of data. The first set of *t*-tests examined species at risk of extinction. For this set “Not Listed”, “Extinct in the wild”, and “Extinct” were eliminated from the test, while the remaining status’ were listed as either “yes” or “no” (vulnerable, endangered, and critically endangered = yes and not defined, data deficient, least concern, and near threatened = no). The second set used every species of turtle and compared the means of listed and not listed species for differing attributes (not listed = no and not defined, data deficient, least concern, near threatened, vulnerable, endangered, critically endangered, extinct in the wild, and extinct = yes). The third set examined the differences between suborders and included their IUCN global status, each given an ascending rank (not listed = 1, not defined or data deficient = 2, least concern = 3, near threatened = 4, vulnerable = 5, endangered = 6, critically endangered = 7, and extinct in the wild or extinct = 8). The fourth set of *t*-tests were the same as the third however excluded sea turtles.

Additional two sample *t*-tests analyzing suborders (Cryptodires vs. Pleurodires) were completed using SYSTAT 13. An ascending rank for each species status category was assigned (least concern = 1, near threatened = 2, vulnerable = 3, endangered = 4, critically endangered = 5, and extinct in the wild and extinct = 6). For a non-parametric equivalent, a Mann-Whitney *U* tests was run comparing the global IUCN status for Cryptodira and Pleurodira using the same ascending numbers. These will help examine if there is a significant difference between each suborder.

The final set of tests was multiple types of regressions using SYSTAT 13. First a complete model was estimated with status rank as the dependent variable and geographical range size (km^2), midpoint latitude, average clutch size (n), and mean female carapace length (mm) were the independent variables. For each species, negative value latitudes (southern hemisphere midpoint) were made positive by first squaring the value, followed by square rooting the value so that a global-scale geographic assessment was possible. The first regression run was a linear regression. This test can help explain how much the attribute variables contribute to the dependent variable, which in this case was global IUCN status, as well as if this contribution is statistically significant. This test included all turtles listed on the IUCN except “Not Defined” and “Data Deficient” and each were assigned an ascending number (1 = least concern, 2 = near threatened, 3 = vulnerable, 4 = endangered, 5 = critically endangered, and 6 = extinct in the wild and extinct). The next test run was the backward stepwise regression, which examines each variable’s contribution and constructs the best model by eliminating the weakest variable(s) first. The third test run was the forward stepwise regression, which looks for the strongest variable(s) first. Both of these tests aid in explaining what variables contribute to the global IUCN status and whether this contribution is significant. For each of the backward and forward stepwise regression tests the same ascending numbers for global IUCN status were used. Finally, an Akaike Information criterion (AIC) test was run. This test attempts to show the best combination of predictor variables as displayed by the lowest score.

RESULTS

Status ranks were available for 266 species (Figure 2). The category with the greatest number of species was "Not Listed" with 91. Numbers in the global IUCN categories ranged from one in the "Not Defined" and "Extinct in the Wild" to "Vulnerable" with 69.

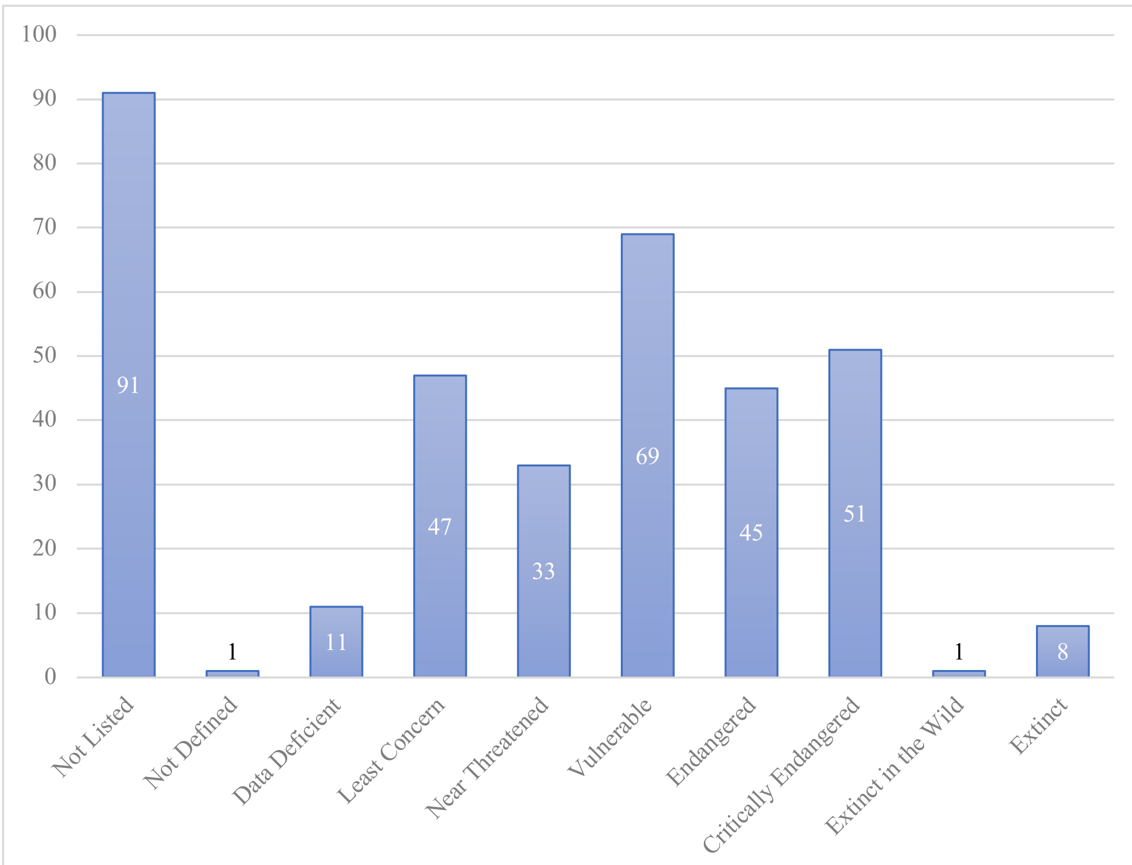

Figure 2. Number of species within each global IUCN Red List category, as well as number of species not listed.

Categories with the highest and lowest mean geographical range (km^2) are "Vulnerable" with 4,350,111 +/- 2,052,324.5 km^2 (SEM) and "Extinct" with 819 +/- 362.1 km^2 (SEM). Categories with the highest and lowest mean midpoint latitude are "Least Concern" with 19.27 (range -32.87 to 43.45º) and "Extinct" with -13.31 (range -21.14 to 0.57º). Categories with the highest and lowest mean clutch size are "Not

Defined" with 97.1 and "Near Threatened" with 6.6 +/- 0.89 (SEM). The "Not Defined" category contains one turtle and the category with the second highest mean clutch size is "Extinct in the Wild". "Extinct in the Wild" also contains one species and the category with the third highest mean clutch size is "Vulnerable" with 17.1 +/- 3.16 (SEM). The categories with the highest and lowest mean female carapace length (mm) are "Extinct" with 680 mm and "Near Threatened" with 194.7 mm (Figure 3).

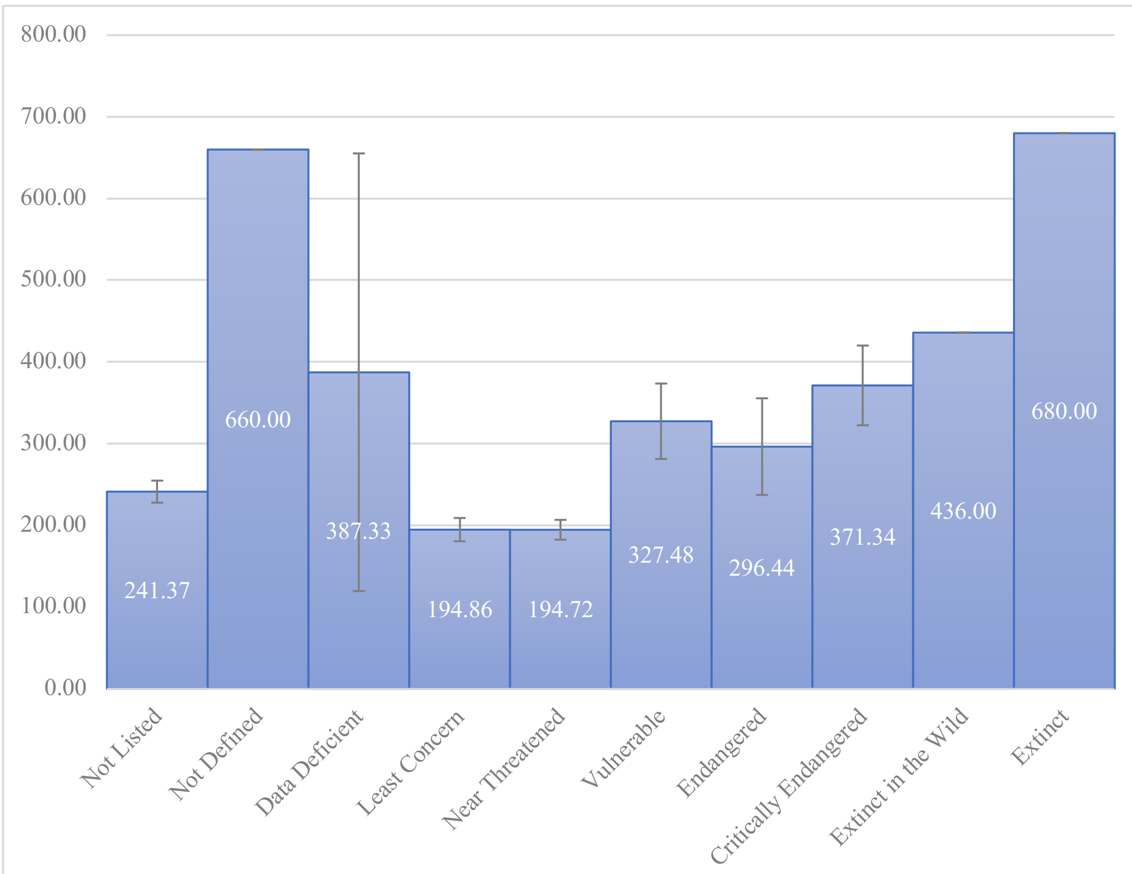

Figure 3. Mean female carapace length (mm) for each category. Bars indicate standard error of the mean.

Excluding sea turtles shows their potential effect on data analysis. The "Data Deficient" category drops drastically from 387.33 mm to 119.5 mm. The "Vulnerable" category drops from 327.48 mm to 263.63 mm, dropping below the "Endangered" category (Figure 4).

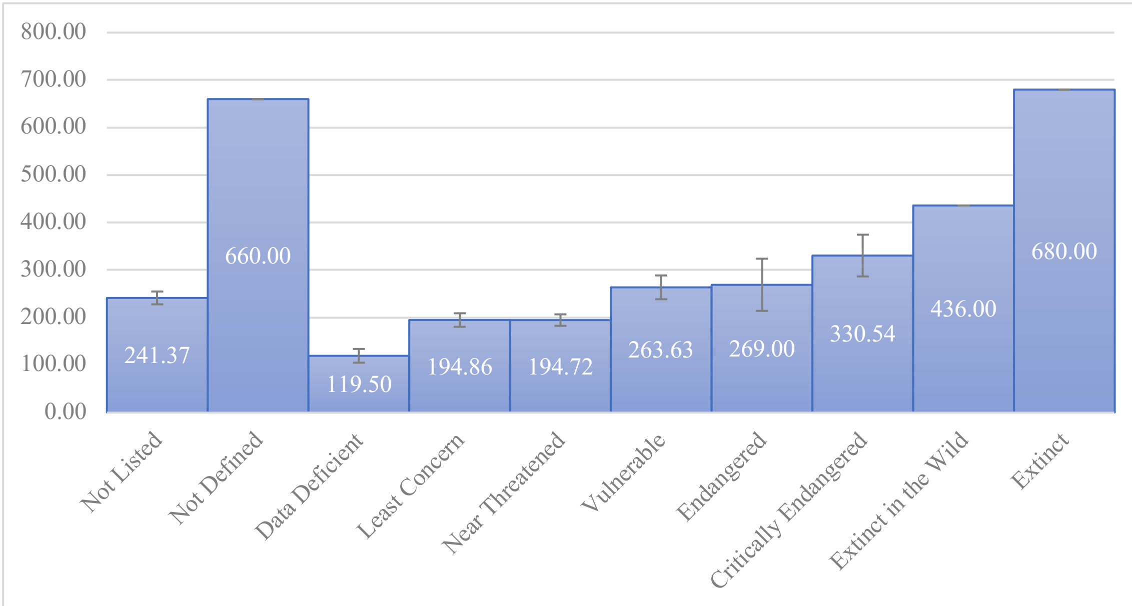

Figure 4. Mean female carapace length (mm) for each category excluding sea turtles. Bars indicate standard error of the mean.

There were 231 turtle species with a midpoint latitude in the northern hemisphere and 126 in the southern hemisphere. Forty-five species in the southern hemisphere were not listed, while 46 in the northern hemisphere were not listed. Seven of the eight extinct species were from the southern hemisphere. Sixty-four percent of the southern hemisphere species were listed on the IUCN, while 80% of the northern hemisphere species were listed. The mean female carapace length of northern hemisphere species was 263 +/- 18.7 mm (SEM) and for southern hemisphere species 296 +/- 26.9 mm (SEM). There was no significant difference in category status (all categories included) between hemispheres (t = -1.58, 222 df, P = 0.115).

There are 94 species within the suborder Pleurodira and 263 species within the Cryptodira suborder. The mean midpoint latitude of Pleurodira was -10.01 (range -32.70 to 16.23°) and for Cryptodira 15.37 (range -33.31 to 45.57°), while the mean geographical range size was 725,993 +/- 104,712.1 km^2 (SEM) and 2,458,894 +/- 916,720.2 km^2 (SEM) respectively. The mean geographical range size of Cryptodira dropped to 631,700 +/- 72,812.8 km^2 (SEM) when sea turtles were removed. Mean clutch sizes of Pleurodira and Cryptodira were 14.22 +/- 1.8 (SEM) and 12.04 +/- 1.4 (SEM) respectively. The mean clutch size of Cryptodira dropped to 8.9 +/- 0.74 (SEM) when sea turtles were removed. The mean female carapace lengths are shown in Figure 5.

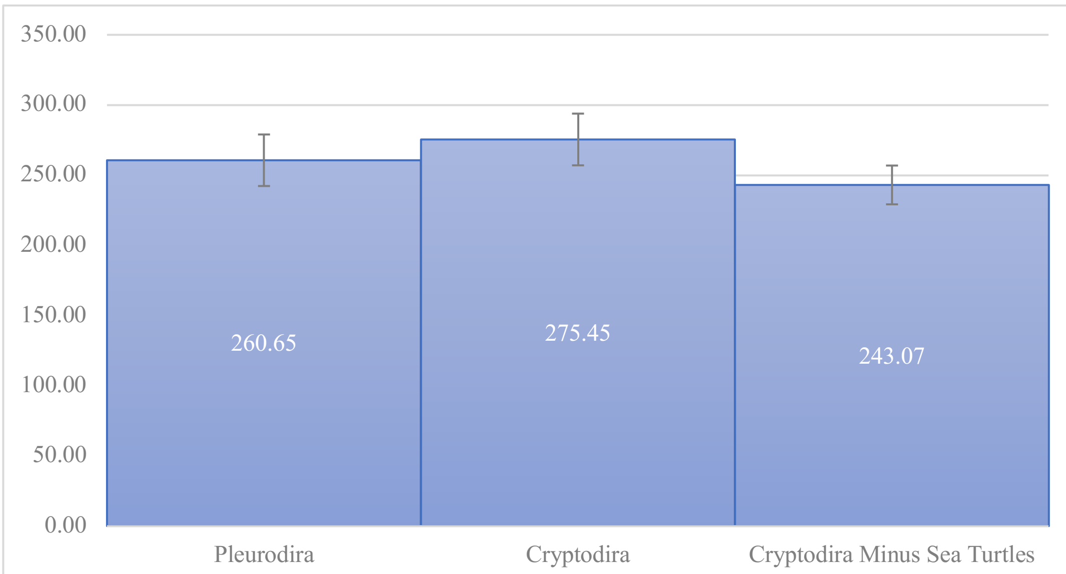

Figure 5. Mean female carapace length (mm) for suborders. Cryptodira is shown both including and excluding sea turtles. Bars indicate standard error of the mean

Geographical range size varied among families (Table 1). The family with the largest mean geographical range size is Dermochelyidae, with one extant member, the Leatherback Sea Turtle (*Dermochelys coriacea*). The family with the second highest mean geographical range is Cheloniidae which contains the remaining sea turtles. The family with the lowest mean geographical range was Staurotypidae. Families with the highest and lowest mean midpoint latitudes are Emydidae and Chelidae respectively. The families with the highest and lowest mean clutch sizes are Cheloniidae and Platysternidae respectively. Families with the highest and lowest mean female carapace length (mm) are Dermochelyidae and Kinosternidae respectively (Table 1).

Table 1. Biological attribute means for each family.

Family	Mean Geographical Range Size (+/- SEM km^2)	Mean Midpoint Latitude (°)	Mean Clutch Size (+/- SEM n)	Mean Female Carapace Length (+/- SEM mm)
Carettochelyidae	435329 +/- N/A	-11.254	15.0 +/- N/A	457 +/- N/A
Chelidae	551615 +/- 128712	-15.022	10.4 +/- 0.84	229 +/- 13.3
Cheloniidae	66482194 +/- 28936490	3.476	104.6 +/- 12.28	794 +/- 49.1
Chelydridae	1197756 +/- 894642	25.784	29.2 +/- 1.98	366 +/- 57.0
Dermatemydidae	137221 +/- N/A	17.320	17.9 +/- N/A	470 +/- N/A
Dermochelyidae	86080919 +/- N/A	7.876	79.8 +/- N/A	1470 +/- N/A
Emydidae	511025 +/- 132055	29.212	9.4 +/- 0.75	199 +/- 10.2
Geoemydidae	442371 +/- 65366	17.922	6.0 +/- 0.92	242 +/- 24.1
Kinosternidae	630701 +/- 290664	23.342	3.1 +/- 0.32	114 +/- 4.6
Pelomedusidae	977539 +/- 194988	-1.943	16.7 +/- 2.91	244 +/- 11.7
Platysternidae	1120779 +/- N/A	21.501	2.3 +/- N/A	N/A
Podocnemididae	1109829 +/- 369015	-1.906	30.9 +/- 10.60	418 +/- 69.1
Staurotypidae	124354 +/- 42794	16.900	6.7 +/- 2.02	190 +/- 52.5
Testudinidae	718761 +/- 181334	-1.914	5.4 +/- 0.72	286 +/- 34.4
Trionychidae	1040968 +/- 256546	17.223	24.7 +/- 4.53	464 +/- 87.1

There are 15 families within the Testudines order. The family with the lowest rank based on listing and global IUCN status is Pelomedusidae and the highest is Dermatemydidae (Figure 6).

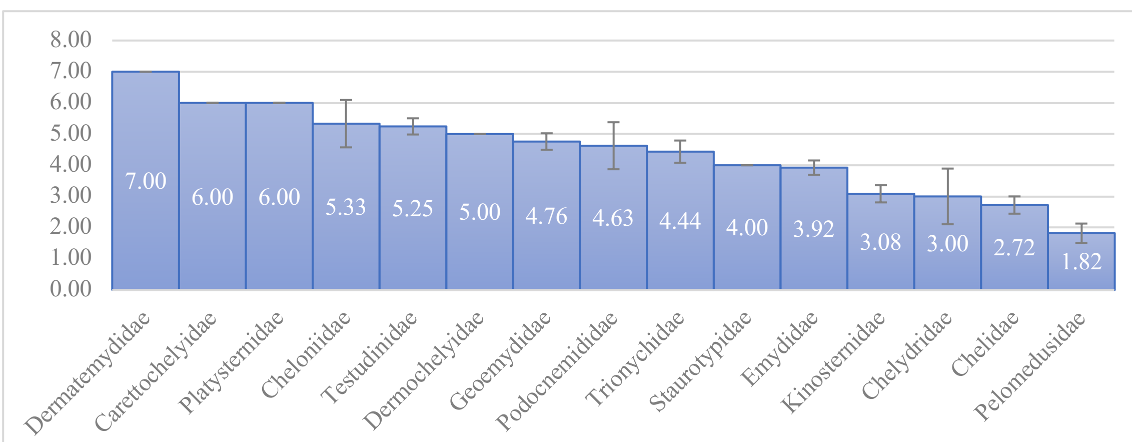

Figure 6. Mean global IUCN status for each family. For this histogram each turtle species was given a rank based on global IUCN status and the mean of these ranks for each family was calculated (not listed = 1, not defined or data deficient = 2, least concern = 3, near threatened = 4, vulnerable = 5, endangered = 6, critically endangered = 7, and extinct in the wild or extinct = 8). Bars indicate standard error of the mean.

The positive correlation between global IUCN status and both mean female carapace length (mm) and LOG mean female carapace length (mm) were highly significant in all six tests, regardless of differing data inclusion parameters. Global IUCN status was negatively correlated and significant with geographical range size in three of six tests, each of which excluded sea turtles. The correlation between global IUCN status and both average clutch size and square root average clutch size was variable in terms of positive and negative and not significant in all but one test, which was marginally significant (Table 2).

Table 2. Pearson correlation test results for Global IUCN Status vs. biological attributes for test one through six. The *r* values are on top of the corresponding shaded *p*-values. Significant results are bolded.

Biological Attribute	Run One	Run Two	Run Three	Run Four	Run Five	Run Six
Range Size (km^2)	0.055	**-0.212**	0.014	**-0.282**	0.028	**-0.264**
	0.296	**<0.001**	0.0824	**<0.001**	0.668	**<0.001**
LOG Range	**-0.357**	**-0.406**	**-0.419**	**-0.469**	**-0.332**	**-0.386**
	<0.001	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
Midpoint Latitude (º)	**0.091**	0.088	**-0.201**	**-0.203**	**-0.144**	**-0.145**
	0.087	0.099	**0.001**	**0.001**	**0.025**	**0.025**
Average Clutch Size (n)	0.079	-0.018	**0.111**	0.042	0.108	0.032
	0.2	0.772	**0.108**	0.548	0.117	0.645
SQRT Clutch	0.034	-0.044	0.068	-0.003	0.061	-0.016
	0.576	0.482	0.325	0.962	0.38	0.815
Mean Female CL (mm)	**0.229**	**0.221**	**0.331**	**0.345**	**0.303**	**0.299**
	0.003	**0.004**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
LOG CL	**0.17**	**0.132**	**0.318**	**0.29**	**0.284**	**0.244**
	0.026	**0.09**	**<0.001**	**<0.001**	**<0.001**	**<0.001**

Average clutch size and mean female carapace length were highly correlated in all six tests. The correlation between geographical range size (km^2) and midpoint latitude was not significant in any of the Pearson correlation tests (Table 3).

Table 3. Pearson correlation test results for biological attributes for test one through six. The *r* values are on top of the corresponding shaded *p*-values. Significant results are bolded.

Biological Attributes	Run One	Run Two	Run Three	Run Four	Run Five	Run Six
Range Size (km²) vs. Midpoint Latitude (º)	-0.025	0.001	-0.04	0.096	-0.048	0.078
	0.632	0.989	0.523	0.131	0.458	0.229
Range Size (km²) vs. Average Clutch Size (n)	**0.602**	**0.133**	**0.648**	**0.22**	**0.648**	**0.223**
	<0.001	**0.032**	**<0.001**	**0.001**	**<0.001**	**0.001**
Range Size (km²) vs. SQRT Clutch	**0.495**	**0.123**	**0.547**	**0.228**	**0.549**	**0.232**
	<0.001	**0.049**	**<0.001**	**0.001**	**<0.001**	**<0.001**
Range Size (km²) vs. Mean Female CL (mm)	**0.5**	0.094	**0.532**	**0.147**	**0.545**	**0.171**
	<0.001	0.227	**<0.001**	**0.091**	**<0.001**	**0.051**
Range Size (km²) vs. LOG CL	**0.371**	0.111	**0.401**	**0.177**	**0.413**	**0.197**
	<0.001	0.156	**<0.001**	**0.042**	**<0.001**	**0.024**
LOG Range vs. Midpoint Latitude (º)	**0.126**	**0.144**	**0.235**	**0.268**	**0.175**	**0.21**
	0.017	**0.007**	**<0.001**	**<0.001**	**0.006**	**0.001**
LOG Range vs. Average Clutch Size (n)	**0.357**	**0.168**	**0.411**	**0.213**	**0.412**	**0.214**
	<0.001	**0.007**	**<0.001**	**0.002**	**<0.001**	**0.002**
LOG Range vs. SQRT Clutch	**0.326**	**0.157**	**0.392**	**0.207**	**0.393**	**0.209**
	<0.001	**0.011**	**<0.001**	**0.003**	**<0.001**	**0.003**
LOG Range vs. Mean Female CL (mm)	**0.185**	-0.113	**0.2**	-0.119	**0.265**	-0.045
	0.015	0.148	**0.018**	0.172	**0.002**	0.612
LOG Range vs. LOG CL	**0.142**	-0.063	**0.151**	-0.073	**0.212**	-0.011
	0.062	0.425	**0.077**	0.401	**0.013**	0.9
Midpoint Latitude (º) vs. Average Clutch Size (n)	-0.042	-0.025	-0.028	0.024	-0.03	0.022
	0.495	0.683	0.682	0.729	0.671	0.76
Midpoint Latitude (º) vs. SQRT Clutch	-0.035	-0.016	0.005	0.052	0.003	0.048
	0.568	0.8	0.94	0.462	0.966	0.493
Midpoint Latitude (º) vs. Mean Female CL (mm)	**-0.143**	-0.128	**-0.134**	-0.115	-0.13	-0.109
	0.061	0.102	**0.116**	0.187	0.131	0.214
Midpoint Latitude (º) vs. LOG CL	**-0.172**	-0.156	**-0.133**	-0.111	**-0.131**	-0.108
	0.024	0.045	**0.118**	0.203	**0.128**	0.221
Average Clutch Size (n) vs. Mean Female CL (mm)	**0.777**	**0.73**	**0.773**	**0.748**	**0.773**	**0.746**
	<0.001	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
Average Clutch Size (n) vs. LOG CL	**0.688**	**0.641**	**0.678**	**0.654**	**0.679**	**0.651**
	<0.001	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
SQRT Clutch vs. Mean Female CL (mm)	**0.81**	**0.745**	**0.812**	**0.748**	**0.811**	**0.745**
	<0.001	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
SQRT Clutch vs. LOG CL	**0.782**	**0.734**	**0.777**	**0.74**	**0.777**	**0.736**
	<0.001	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**

None of the geographical range size *t*-tests showed a statistically significant difference between means (Table 4). The midpoint latitude *t*-tests showed statistically significant differences in three of four tests. Both *t*-tests that included global IUCN status showed a statistically significant difference. These tests were also run on the suborders, one including all 357 turtles and the other excluding the seven sea turtles (Table 4).

Table 4. Results of various *t*-tests. Statistically significant tests are bolded. For each test the following are listed in descending order: *t*-value, df value, *p*-value.

t-test	At Risk of Extinction	Listed	Suborder	Suborder (no sea turtles)
Geographical Range Size (km^2)	1.767 167 0.079	1.661 275 0.098	1.878 269 0.061	-0.739 189 0.461
LOG Range	**-3.474** **254** **<0.001**	**-5.051** **295** **<0.001**	-1.360 200 0.175	-1.909 192 0.058
Midpoint Latitude (°)	-1.486 161 0.139	**4.511** **182** **<0.001**	**14.806** **241** **<0.001**	**14.889** **244** **<0.001**
Average Clutch Size (n)	**2.123** **212** **0.035**	1.476 180 0.142	-0.956 136 0.341	**-2.721** **78** **0.008**
SQRT Clutch	1.750 214 0.082	0.559 99 0.577	**-2.720** **127** **0.007**	**-4.192** **93** **<0.001**
Mean Female CL (mm)	**3.534** **115** **<0.001**	1.660 135 0.099	0.569 102 0.571	-0.765 71 0.447
LOG CL	**3.355** **132** **0.001**	-0.318 83 0.751	-1.194 82 0.236	**-2.160** **72** **0.034**
Global IUCN Status	N/A N/A N/A	N/A N/A N/A	**7.552** **161** **<0.001**	**7.434** **164** **<0.001**

Global IUCN status did not differ between orders Pleurodira vs. Cryptodira (separate variance t = 1.37, 52.18 df, P = 0.177; pooled variance t = 1.33, 252 df, P =

0.186). A non- parametric equivalent test concurred (Mann-Whitney U = 4,682, 1 df, P = 0.57).

A complete multivariate regression model (geographical range size, midpoint latitude, carapace length, and clutch size) explained 14.3% of the global IUCN status value (F = 5.44; 4, 130 df; P < 0.001; R^2 = 0.143).

Both forward and backward stepwise multiple regression produced the same highly significant model with midpoint latitude and carapace length (F = 12.24; 2, 136 df; P < 0.001; R^2 = 0.153).

The best AIC model found included latitude, carapace length, and clutch size, and explained 13.4% of the IUCN status. This model produced essentially the same level of description (ΔAIC<2) as the complete model which explained 14.3% (Table 5).

Table 5. Results of the AIC test. The individual or combination of attributes with the lowest AIC score indicates the best option. The R squared value, derived from multiple regression, represents the percent the correlating attributes can explain the global IUCN status. Note: Lat = midpoint latitude (°), CL = mean female carapace length (mm), Clutch = clutch size (n), and Range = geographical range size (km^2). Schwarz Criterion also shown (BIC).

Attributes	AIC	AICc	BIC	R^2
Lat+CL+Clutch	469.4	469.9	483.9	0.134
Range+Lat+CL+Clutch	470	470.6	487.4	0.143
Range+CL+Clutch	474.3	474.8	488.8	0.102
Range+Lat+CL	480.4	480.9	495.1	0.167
Lat+CL+Clutch	480.8	481.1	492.5	0.153
CL	485.6	485.8	494.4	0.11
Range+CL	485.7	486	497.4	0.122
Lat+Clutch	736.9	737.1	750.3	0.066
Range+Lat+Clutch	737.9	738.2	754.7	0.071
Clutch	746.7	746.8	756.8	0.012
Range+Clutch	748.2	748.4	761.9	0.015
Lat	899.9	900	910.5	0.074
Range+Lat	901.6	901.8	915.8	0.075
Range	919.4	919.5	930	0

DISCUSSION

The results include 91 turtle species not listed on the global IUCN Red List. This can be misleading, as this is not an indication of assessment but merely an indication of listing. According to Rhodin *et al.* (2017) some of the species within the "Not Listed" category in this study have been assessed, while others have not. For the purpose of this study, there were considered to be 266 turtle species listed on the global IUCN Red List. This is eight more than were listed on the IUCN Red List at time of data collection and reflects taxonomic revisions separating species that were included within the global IUCN Red List listing of other species. Although unlikely, it is possible that this was the case for other species as well and it was missed during the research process. There has been a species added to the global IUCN Red List since time of data collection. *Elseya rhodini*, which was not listed at time of data collection, has been added to the "Least Concern" category (IUCN 2020b). The addition of this species as well as the eight species included for the purpose of this study brings the total species listed on the IUCN Red List to 267. This study recognized a total of 357 species therefore this would indicate 74.8% of Testudines are listed on the IUCN Red List. As Rhodin *et al.* (2017) and IUCN (2019f) were used to compile the list of 357 species, the newly discovered *Pelodiscus variegatus* was not included in this study (Farkas *et al.* 2019).

The results show the "Vulnerable" category having the highest mean geographical range size with a value of 4,350,111 km^2. This is misleading as the "Vulnerable" category contains three sea turtle species, which undoubtedly inflates the mean geographical range size. The mean geographical range size of non-sea turtle Testudines is 657,024.2 km^2, but 69,282,011.5 km^2 for sea turtles. When removing the sea turtles, the "Vulnerable" category saw its mean geographical range drop to 807,694.6 km^2. The "Not Listed" category then had the highest mean geographical range with a value of 869,328.9 km^2. This begins to show the impact the inclusion or exclusion of sea turtles can have on the analyses of data for Testudines. This was an issue recognized by Hecnar (1999a) as sea turtles were not included in a study exploring geographic range sizes "because their range sizes are poorly known and they have a different mode of life". The impact of sea turtles is seen in other attributes as well. For example, the "Vulnerable" category has a mean female carapace length of 327 mm including sea turtles but 264 mm excluding sea turtles, dropping below the "Endangered" category which falls from 296 mm to 269 mm, as seen in the results section in Figures 3 and 4.

The impact of sea turtles is further exemplified within the results of the Pearson correlation tests (Table 2). Each run excluding sea turtles shows a statistically significant correlation between geographic range size and global IUCN status, but each run including them shows the opposite. A similar effect is seen within the Pearson correlation tests between midpoint latitude and LOG CL, LOG range and LOG CL, and LOG range and mean female carapace length (mm). In each of these cases, the tests ran including sea turtles showed a significant correlation and the test ran excluding sea turtles showed no significant correlation. This difference is once again seen when examining the mean clutch size of all species between Cryptodira and Pleurodira. A *t*-test showed no significant difference when including sea turtles but showed a significance difference when sea turtles were excluded.

This however was not the case when examining the global IUCN status of suborders using *t*-tests. When including all categories involved in this study there was a strongly significant difference between suborders whether sea turtles were included or not. However, when excluding "Not Listed", "Not Defined", and "Data Deficient" and examining global IUCN status of suborders the separate and pooled variance tests showed no significant difference with *p*-values of 0.177 and 0.186 respectively. This can also begin to exemplify the impact of including and excluding differing categories during analyses of data.

Mean female carapace length appeared to be the attribute most strongly related to the global IUCN status. This can be observed in the Pearson correlation tests as each of the six runs show a significant correlation between mean female carapace length and global IUCN status. This connection was again evident when a *t*-test found a significant difference between mean female carapace length of species at risk and not at risk of extinction. Both multiple regression models included mean female carapace length and these tests were highly statistically significant ($F = 12.24$; 2, 136 df; $P < 0.001$; $R^2 = 0.153$). The standard coefficient of midpoint latitude and mean female carapace length was -0.231 and 0.23 respectively, meaning about 46% of the R squared value can be explained by these two variables. The tolerance values for each was 0.81, meaning these two variables are relatively independent of one another.

This connection was also seen in the AIC test as mean female carapace length was included in each of the top seven AIC scores and zero of the remaining seven options. It also had by far the best individual score with 485, with the remaining attributes scoring 746.7-919.4 individually. The same AIC test indicated that mean female carapace length (mm) could explain 11% of a species global IUCN status, while midpoint latitude, clutch size, and geographical range offered 7.4%, 1.2%, and 0% respectively. If this correlation is correct, it would not be specific to turtles as animals with large body size are often more susceptible to extinction (Cardillo *et al.* 2005). As expected, there was also a strong connection between mean female carapace length and clutch size.

The connection between global IUCN status and mean female carapace length may be related to anthropogenic activities. There are many places on Earth where humans eat turtles and it is logical to deduce that they would prefer to eat habitually larger turtles. Conway-Gomez (2007) examined two species within the *Podocnemis* genus and found that turtle abundance was negatively impacted by hunting pressure and this negative impact was positively correlated with proximity to human communities. The *Podocnemis* genus in my study had a mean female carapace length of 442 mm, which is high. Only one of six *Podocnemis* turtles were not listed on the IUCN Red List, one of these is critically endangered. Conway-Gomez (2007) examined both *Podocnemis expansa* and *P. unifilis*, which are both listed on the IUCN Red List, *P. unifilis* being vulnerable and thus considered at risk of extinction. Humans eating turtles is by no means a new phenomenon. Frazier *et al.* (2018) found evidence of the intense exploitation of sea turtles in Oman up to 6,500 years ago, as well as evidence that some communities of humans worshipped turtles, finding turtle bones and skulls within human graves. This indicates turtles were not only utilized as a nutritional resource but offered cultural significance as well.

According to Harris and Pimm (2008) "small geographical range size is the single best predictor of threat of extinction in terrestrial species". This notion of a correlation between risk of extinction and small geographic range sizes is also offered in Runge *et al.* (2015). My study did not show geographical range size as the most significant factor in determining global IUCN status. The Pearson correlation tests showed a significant correlation between geographic range size and IUCN status for the three out of six runs which excluded the sea turtles. The *t*-tests examining species that are and are not at risk of extinction and the listed vs. non listed turtles both showed no significant difference. This attribute was not included in the forward stepwise multiple regression and was eliminated in the backward stepwise multiple regression while also having the lowest individual attribute AIC score and *R* squared value in the AIC test results. As supported by the Pearson correlation tests, the lack of importance in determining IUCN status found within this study may be directly tied to the inclusion of sea turtles in data analysis.

It is somewhat surprising that clutch size was not more important in determining global IUCN status, as mean female carapace length (mm) and clutch size are so highly correlated. All six Pearson correlation tests showed a highly significant correlation between clutch size and mean female carapace length (mm). Only one of six Pearson correlation tests showed a significant correlation between global IUCN status and clutch size, however this was marginally significant. Clutch size even had the second lowest *R* squared value in the AIC test, explaining a mere 1.2% of the global IUCN status. There was however shown to be a significant difference between the clutch sizes of the at risk and not at risk of extinction turtles. This likely stems from its association with mean female carapace length (mm) as the mean female carapace length of species that are at risk of extinction and not at risk of extinction were 330 +/- 29.5 mm (SEM) and 211 +/- 16.3 mm (SEM) respectively.

There are several potential sources of error within this study as well as attributes that were not explored. Because of the process used in calculating geographical range size (km^2) and midpoint latitude, it is impossible to state the values for each species are

100% accurate. Although minimal, this could impact the geographical range size category. As the range extent was used to calculate geographical range, the calculated value could be inflated in comparison to area of occupancy. Ramesh (2017) noted range extent often includes unsuitable habitat resulting in the inflation of a species range. The range extent is found by calculating the area within the boundary whereas area of occupancy seeks to eliminate areas of unsuitable or unoccupied habitat and includes the areas within the range extent a species occupies (Figure 7) (IUCN 2001).

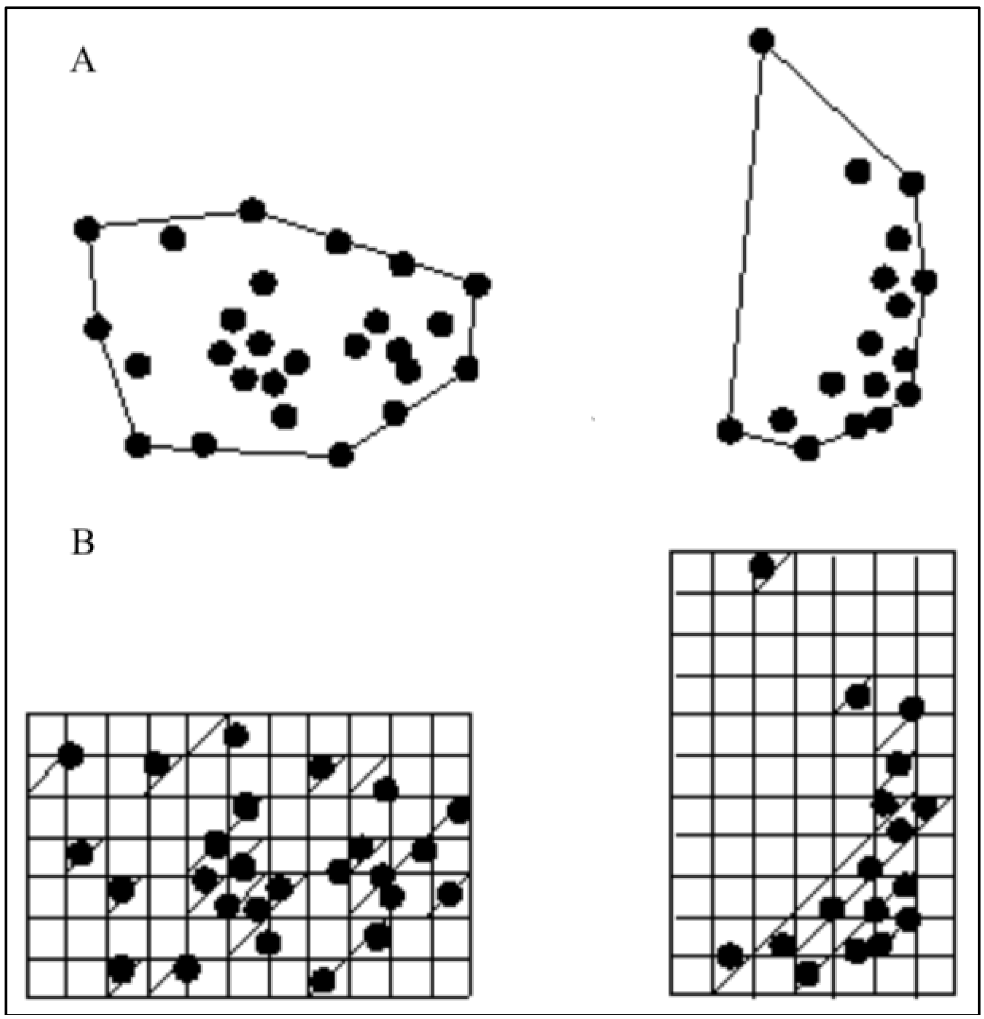

Figure 7. Range extent (A) vs. area of occupancy (B). In range extent the area is calculated as the area within the boundary. For area of occupancy the area is calculated by summing the occupied squares (as marked by the diagonal lines). Notice how different results could be produced using each method (Adapted from IUCN 2001).

The outer boundary of a range also may not always be representative of species abundance. Fortin *et al.* (2005) stated "it is important to identify internal distribution of abundance within range boundaries". The shape of polygons used to outline distributions can also be a point of controversy. The issue can be illustrated using the distribution map of the Common Snapping Turtle (*Chelydra serpentina*) provided within Rhodin *et al.* (2017) and used in this study to calculate geographical range size and midpoint latitude (Figure 8).

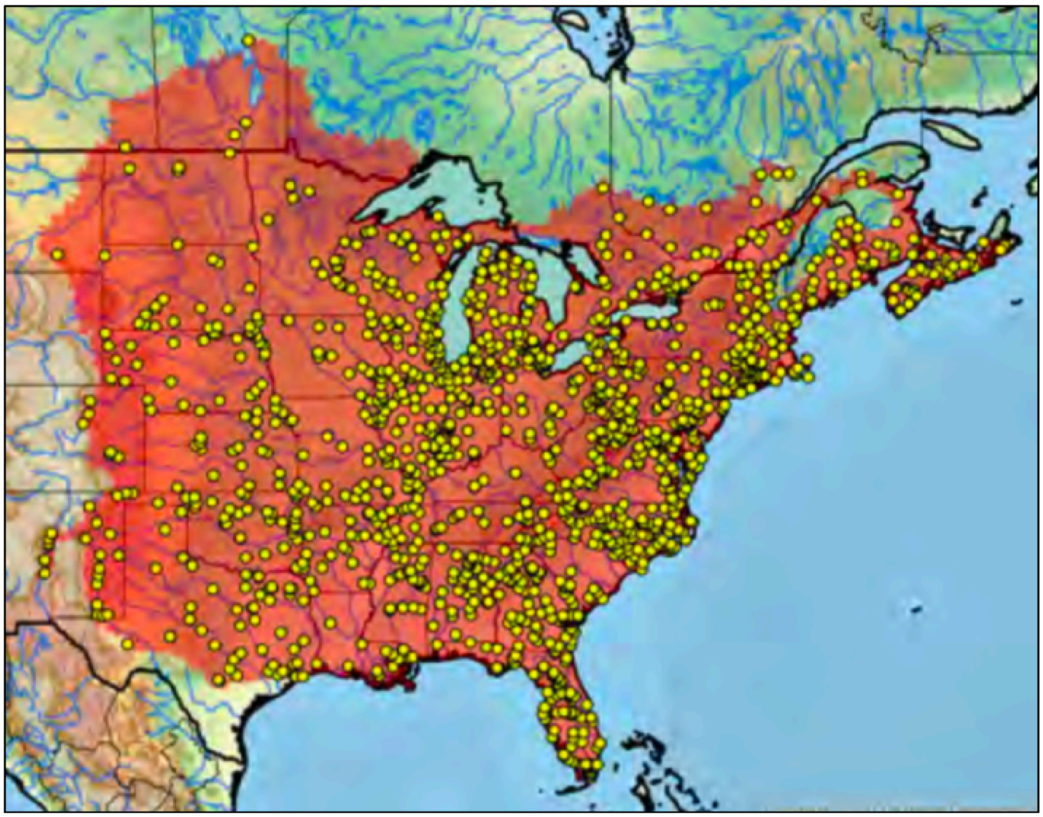

Figure 8. Common Snapping Turtle distribution map (Rhodin *et al.* 2017).

Notice the most northwesterly portion of the distribution has very few distribution dots in comparison to much of the map and the range extends beyond distribution points. A study by Palminteri *et al.* (2011) explored the use of range polygons, acknowledging their shortcomings and their potential for overestimation.

The process of calculating midpoint latitude would not result in 100% accuracy, meaning the midpoint latitude values are not perfect. The analyses may have been impacted by missing data as only 267 clutch sizes and 172 mean female carapace lengths were located during the research process. If there was more available data, it could have impacted the results. For example, only one mean female carapace length was found for a species listed as “Extinct”.

The subject of this paper could have been further explored with the inclusion of attributes such as longitude. Examination of continents could have helped further explore the connection between IUCN status and various attributes, as well as exploring the connection between continent located and IUCN status. Analyses of continents may help explore regional anthropogenic effects.

It is interesting to note that four of the top six families in terms of mean global IUCN status contained one turtle. The two that did not were Cheloniidae (mean global IUCN status: 5.33) and Testudinidae (mean global IUCN status: 5.25). Testudinidae is the most terrestrial of the Testudine families (Wyneken *et al.* 2008). Cheloniidae are negatively impacted by fishing practices and plastic pollutants, while also being dependent on beaches for nesting (Assuncao Ivar do Sul *et al.* 2010; WWF 2020). Over 33% of the global human population lives within 100 km of an ocean’s coastline (NASA 2020). It is fair to wonder if it is their inherent relationship with humans that has caused high mean global IUCN status.

CONCLUSION

Global biodiversity is currently under attack (Ceballos *et al.* 2017). Many Testudine species are at risk of extinction and there is a need for increased conservation efforts. Testudines are the subject of taxonomic bias, as they are often underrepresented in wildlife journals, post-secondary library holdings, and reintroduction programs (Seddon *et al.* 2005; Hecnar 2009; Christoffel and Lepczyk 2012). Although facing many threats, one of the most serious threats to Testudines is habitat loss (Lesbarreres *et al.* 2014). My study indicates that there is a positive correlation between female carapace length and global IUCN status. This was supported by Pearson correlation tests, forward and backward stepwise multiple regressions, as well as an AIC test. It is possible that poaching and human consumption plays a role in this correlation. The impact of including sea turtles in analyses was evident throughout this study as they often have larger clutch and body sizes as well as significantly larger geographical range sizes than other Testudines. The two families containing greater than one turtle with the highest mean global IUCN status are Cheloniidae and Testudinidae. There are many threats facing Testudines today. Humans can potentially have a positive impact on the current state of Testudines by offering more time and funding to the conservation of Testudines while also minimizing or reversing human caused threats such as habitat loss or fragmentation, road mortality, and poaching.

LITERATURE CITED

Akani, G. C., Fabio Petrozzi, Gabriel Hoinsoude Segniagbeto and Luca Luiselli. 2015. Notes on morphology, biology and domestic consumption of *Pelusios niger* (DUMERIL, & BIBRON, 1835) from Forcados River, Nigeria. Herpetozoa 28(1-2):94-98.

Aryal, Prakash Chandra, Man Kumar Dhamala, Bed Prasad Bhurtel, Madan Krishna Suwal and Bishal Rijal. 2010. Turtles of Nepal: A Field Guide for Species Accounts and Distribution. Environmental Graduates in Himalaya (EGH), Resources Himalaya Foundation and Companions for Amphibians and Reptiles of Nepal (CARON).

Ashley, Paul, Amanda Kosloski and Scott A. Petrie. 2007. Incidence of Intentional Vehicle-Reptile Collisions. Human Dimensions of Wildlife 12(3):137-143.

Ashton, Kyle G., Russell L. Burke and James N. Layne. 2007. Geographic Variation in Body and Clutch Size of Gopher Tortoises. Copeia 2007(2):355-363.

Assuncao Ivar do Sul, Juliana, Isaac R. Santos, Ana Claudia Friedrich, Alexandre Matthiensen and Gilberto Fillmann. 2011. Plastic Pollution at a Sea Turtle Conservation Area in NE Brazil: Contrasting Developed and Undeveloped Beaches. Estuaries and Coasts 34(4):814-823.

Bager, Alex, Thales R. O. de Freitas and Ligia Krause. 2007. Nesting Ecology of a Population of *Trachemys dorbignyi* (Emydidae) in Southern Brazil. Herpetologica 63(1):56-65.

Balani, Kantesh, Riken R. Patel, Anup K. Keshri, Debrupa Lahiri and Arvind Agarwal. 2011. Multi-scale hierarchy of *Chelydra serpentina*: Microstructure and mechanical properties of turtle shell. Journal of the Mechanical Behaviour of Biomedical Materials 4(7):1440-1451.

Behler, John L. 2000. Letter from the IUCN Tortoise and Freshwater Turtle Specialist Group. Turtle and Tortoise Newsletter (1):4-5.

Berry, James F. and Richard Shine. 1980. Sexual size dimorphism and sexual selection in turtles (order Testudines). Oecologia 44(2):185-191.

Bock, Brian C., Vivian P. Paez and Juan M. Daza. 2010. *Trachemys callirostris* (Gray 1856) - Colombian Slider, Jicotea, Hicotea, Galapago, Morrocoy de Agua. August 7. https://iucn-tftsg.org/wp-content/uploads/file/Accounts/crm_5_042_callirostris_v1_2010.pdf. January 2020.

Bohm, Stephan. 2011. Observations on the South American yellow-footed tortoise (*Chelonoidis denticulata*) in Fench Guiana. https://www.researchgate.net/publication/257871424_Observations_on_the_South_American_yellow-footed_tortoise_Chelonoidis_denticulata_in_French_Guiana. March 2020.

Booth, David T. 1998. Egg Size, Clutch Size, and Reproductive Effort of the Australian Broad-shelled River Turtle, *Chelodina expansa*. Journal of Herpetology 32(4):592-596.

Bour, Roger, Luca Luiselli, Fabio Petrozzi, Gabriel Hoinsoude Segniagbeto and Laurent Chirio. 2016. *Pelusios castaneus* (Schweigger 1812) - West African Mud Turtle, Swamp Terrapin. March 15. https://www.researchgate.net/publication/298346453_Pelusios_castaneus_Schweigger_1812_-_West_African_Mud_Turtle_Swamp_Terrapin. January 2020.

Bower, Deborah S. and Kate M. Hodges. 2014. *Chelodina expansa* Gray 1857 - Broad-shelled Turtle, Giant Snake-Necked Turtle. January 6. https://www.researchgate.net/profile/Kate_Hodges/publication/260640115_Chelodina_expansa_Gray_1857_-_Broad-Shelled_Turtle_Giant_Snake-Necked_Turtle/links/00463531e799d12720000000.pdf. January 2020.

Boyer, Thomas H. and Charles J. Innis. 2019. Mader's Reptile and Amphibian Medicine and Surgery: Third Edition.

Branch, Bill. 2016. Pocket Guide: Snakes and other Reptiles of Southern Africa. Cape Town: Struik Nature. 160 pp.

Broadley, Donald G. 1981. A review of the genus Pelusios Wagler in southern Africa (Pleurodira: Pelomedusidae). Occasional Papers of the National Museums and Monuments of Rhodesia, B. Natural Sciences 6(9):633-686. https://iucn-tftsg.org/wp-content/uploads/file/Articles/Broadley_1981.pdf. January 2020.

Braun, Joanne and Garrett R. Brooks Jr. 1987. Box Turtles (*Terrapene carolina*) as Potential Agents for Seed Dispersal. The American Midland Naturalist 117(2):312-318.

Buhlmann, Kurt A., Thomas S.B. Akre, John B. Iverson, Deno Karapatakis, Russell A. Mittermeier, Arthur Georges, Anders G.J. Rhodin, Peter Paul van Dijk and J. Whitfield Gibbons. 2009. A Global Analysis of Tortoise and Freshwater Turtle Distributions with Identification of Priority Conservation Areas. Chelonian Conservation and Biology 8(2):116-149.

Campbell, Lisa M. 2012. Seeing Red: Inside the Science and Politics of the IUCN Red List. Conservation & Society 10(4):367-380.

Cann, John. 1997a. Georges short-necked turtle. Monitor (Journal of the Victorian Herpetological Society) 9(1):18-23.

Cann, John. 1997b. Irwin's turtle. Monitor (Journal of the Victorian Herpetological Society) 9(1): 36-40.

Cann, John and John M. Legler. 1994. The Mary River Tortoise: A New Genus and Species of Short-Necked Chelid from Queensland, Australia (Testudines: Pleurodira). Chelonian Conservation and Biology 1(2):81-96.

Cardillo, Marcel, Georgina M. Mace, Kate E. Jones, Jon Bielby, Olaf R.P. Bininda-Emonds, Wes Sechrest, C. David L. Orme and Andy Purvis. 2005. Multiple Causes of High Extinction Risk in Large Mammal Species. Science 309: 1239-1241. https://science.sciencemag.org/content/309/5738/1239. March 2020.

Ceballos, Gerardo, Paul R. Ehrlich and Rodolfo Dirzo. 2017. Biological annihilation via the ongoing sixth mass extinction signaled by vertebrate population losses and declines. Proceedings of the National Academy of Sciences of the United States of America https://www.pnas.org/content/114/30/E6089.full. April 2020.

Chen, T. H. and I. J. Cheng. 1995. Breeding biology of the green turtle, *Chelonia mydas*, (Reptilia: Cheloniidae) on Wan-An Island, Peng-Hu Archipelago, Taiwan. I. Nesting ecology. Marine Biology 124: 9-15.

Christoffel, Rebecca A. and Christopher A. Lepczyk. 2012. Representation of herpetofauna in wildlife research journals. The Journal of Wildlife Management 76(4):661-669.

CITES. 2013. Convention on International Trade in Endangered Species of Wild Fauna and Flora. March. https://cites.org/sites/default/files/eng/cop/16/prop/E-CoP16-Prop-38.pdf. January 2020.

CITES. 2018. Turtles and Tortoises Demographic Traits Database for CITES Listed Species ver. 01. October 31. https://www.species360.org/serving-conservation/turtles-tortoises-cites/. January 2020.

Clay, B.T. 1981. Observations on the breeding biology and behaviour of the long-necked tortoise, *Chelodina oblonga*. Journal of the Royal Society of Western Australia 4(1):27-32.

Collins, James P. and Martha L. Crump. 2009. Extinction in Our Times: Global Amphibian Decline. New York: Oxfor University Press. 273 pp.

Cummings, Kristy L., Shellie R. Puffer, Jenny B. Holmen, Jason K. Wallace, Jeffrey E. Lovich, Kathie Meyer-Wilkins, Chris Peterson and Robert E. Lovich. 2018. Biodiversity of the amphibians and reptiles at the Camp Cady Wildlife Area, Mojave Desert, California and comparisons with other desert locations. California Fish and Game 104(3):129-147.

Cunha, Fabio A.G., Thaisa Fernandes, Jabson Franco and Richard C. Vogt. 2019. Reproductive Biology and Hatchling Morphology of the Amazon Toad-headed Turtle (*Mesoclemmys raniceps*) (Testudines: Chelidae), with Notes on Species Morphology and Taxonomy of the *Mesoclemmys* Group. Chelonian Conservation and Biology 18(2).

Currie, Dave, Joseph M. Wunderle JR., Ethan Freid, David N. Ewert and D. Jean Lodge. 2019. The Natural History of The Bahamas: A Field Guide. Ithaca and London: Cornell University Press. 453 pp.

Das, Indraneil, Dhruvajyoti Basu and Shailendra Singh. 2010. *Nilssonia hurum* (Gray 1830) - Indian Peacock Softshell Turtle. December 14. https://www.researchgate.net/publication/299637631_Nilssonia_hurum_Gray_1830_-_Indian_Peacock_Softshell_Turtle. January 2020.

Demaya, Gift Simon, John Sebit Benansio, Thomas Francis Lado, Tomas Diagne, Daniele Dendi and Luca Luiselli. 2019. Rediscovery of the Nubian Flapshell Turtle (*Cyclanorbis elegans*) in South Sudan. Chelonian Conservation and Biology 18(1):62-67.

Diesmos, Arvin C., James R. Buskirk, Sabine Schoppe, Mae Lowe L. Diesmos, Emerson Y. Sy and Rafe M. Brown. 2012. *Siebenrockiella leytensis* (Taylor 1920) - Palawan Forest Turtle, Philippine Forest Turtle. December 29. https://iucn-tftsg.org/wp-content/uploads/file/Accounts/crm_5_066_leytensis_v1_2012.pdf. January 2020.

Enge, Kevin M., Travis M. Thomas and Eric Suarez. 2014. Population Status, Distribution, and Movements of the Alligator Snapping Turtle in the Suwannee River, Florida. https://www.researchgate.net/profile/Kevin_Enge/publication/288838103_Enge_K_M_T_M_Thomas_and_E_Suarez_2014_Population_status_distribution_and_movements_of_the_alligator_snapping_turtle_in_the_Suwannee_River_Florida_Final_report_Florida_Fish_and_Wildlife_. January 2020.

Ernst, Carl H. 2003a. *Trachemys callisrostris*. https://repositories.lib.utexas.edu/bitstream/handle/2152/45501/0768_Trachemys_callirostris.pdf?sequence=1&isAllowed=y. March 2020.

Ernst, Carl H.. 2003b. *Trachemys yaquia*. https://repositories.lib.utexas.edu/bitstream/handle/2152/45502/0769_Trachemys_yaquia.pdf?sequence=1&isAllowed=y. March 2020.

Ernst, Carl H. and Michael E. Seidel. 2006. *Trachemys venusta*. https://repositories.lib.utexas.edu/handle/2152/44845. March 2020.

Ernst, Carl H. and Roger W. Barbour. 1989. Turtles of the World. Smithsonian Institution. 313 pp.

Farkas, Balazs, Thomas Ziegler, Cuong The Pham, An Vinh Ong and Uwe Fritz. 2019. A new species of *Pelodiscus* from northeastern Indochina (Testudines, Trionychidae). Zookeys 824:71-86. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6382751/. March 2020.

Fielder, Darren, Bruce Chessman and Arthur Georges. 2015. *Myuchelys bellii* (Gray 1844) - Western Saw-shelled Turtle, Bell's Turtle. September 6. https://www.researchgate.net/publication/281526424_Myuchelys_bellii_Gray_1844_-_Western_Saw-shelled_Turtle_Bell's_Turtle. January 2020.

Florida Fish and Wildlife. 2019. Gopher Tortoise Program. https://myfwc.com/wildlifehabitats/wildlife/gopher-tortoise/. November 2019.

Ford, Neil B. and Richard A. Seigel. 1989. Relationships among Body Size, Clutch Size, and Egg Size in Three Species of Oviparous Snakes. Herpetologica 45 (1): 75-83.

Fortin, M.-J., T. H. Keitt, B. A. Maurer, M. L. Taper, Dawn M. Kaufman and T. M. Blackburn. 2005. Species' geographic ranges and distributional limits: pattern analysis and statistical issues. http://www.seaturtle.org/PDF/Fortin_2005_Oikos.pdf. April 2020.

Frazier, John G., Valentina Azzara, Olivia Munoz, Lapo Gianni Marcucci, Emilie Badel, Francesco Genchi, Maurizio Cattani, Maurizio Tosi and Massimo Delfino. 2018. Remains of Leatherback turtles, *Dermochelys coriacea*, at Mid-Late Holocene archaeological sites in coastal Oman: clues of past worlds. Peer J https://peerj.com/articles/6123/. March 2020.

Freeman, Alastair, Scott Thomson and John Cann. 2014. *Elseya lavarackorum* (White and Archer 1994) - Gulf Snapping Turtle, Gulf Snapper, Riversleigh Snapping Turtle, Lavarack's Turtle. December 12. https://www.researchgate.net/publication/269432970_Chelidae_-_Elseya_lavarackorum_Elseya_lavarackorum_White_and_Archer_1994_-_Gulf_Snapping_Turtle_Gulf_Snapper_Riversleigh_Snapping_Turtle_Lavarack's_Turtle. January 2020.

Furtado, J. I. 1988. Key Environments: Malaysia. Edited by Earl of Cranbrook. Pergamon Press. 316 pp.

Gaikhorst, G. S., B. R. Clarke, M. McPharlin, B. Larkin, J. McLaughlin and J. Mayes. 2011. The captive husbandry and reproduction of the pink-eared turtle (*Emydura victoriae*) at Perth Zoo. Zoo Biology 30(1):79-94.

Georges, Arthur, Fiorenzo Guarino and Biatus Bito. 2006. Freshwater turtles of the TransFly region of Papua New Guinea - notes on diversity, distribution, reproduction, harvest, and trade. Wildlife Research 33(5):373-384.

Gerlach, Justin. 2008. *Pelusios subniger parietalis* Bour 1983 - Seychelles Black Mud Turtle. June 30. https://iucn-tftsg.org/wp-content/uploads/file/Accounts/crm_5_016_parietalis_v1_2008.pdf. January 2020.

Germano, David J. and J. Daren Riedle. 2015. Population Structure, Growth, Survivorship, and Reproduction of *Actinemys marmorata* from a High Elevation Site in the Tehachapi Mountains, California. Herpetologica 71(2):102-109.

Gibbs, James P. and W. Gregory Shriver. 2002. Estimating the effects of Road Mortality on Turtle Populations. Conservation Biology 16(6):1647-1652.

Google. 2019. Maps. https://www.google.com/maps.

Government of Canada. 2016. Management Plan for the Snapping Turtle (*Chelydra serpentina*) in Canada. https://www.registrelep-sararegistry.gc.ca/virtual_sara/files/plans/mp_snapping%20turtle_e_proposed.pdf. February 2020.

Government of Canada. 2019. Leatherback Sea Turtle (Canadian Pacific population). https://www.dfo-mpo.gc.ca/species-especes/profiles-profils/leatherbackturtlepacific-tortueluthpacifique-eng.html. October 2019.

Government of Ontario. 2019. Snapping turtle. https://www.ontario.ca/page/snapping-turtle. February 2020.

Government of Western Australia. 2020. South-western snake-necked turtle - *Chelodina colliei*. https://rivers.dwer.wa.gov.au/species/chelodina-colliei/. January 2020.

Green, Darren. 2014. Keeping Short-necked Turtles *Emydura* species. Queensland: Australian Reptile Keeper Publications. 35 pp.

Harris, Grant and Stuart L. Pimm. 2008. Range Size and Extinction Risk in Forest Birds. Conservation Biology 22(1):163-171.

Hecnar, Stephen J. 1999a. Patterns of turtle species' geographic range size and a test of Rapoport's rule. Ecography 22(4):436-446.

Hecnar, Stephen J. 1999b. Patterns of turtle species' geographic range size and a test of Rapoport's rule (unpublished hand drawn turtle maps). Ecogeography 22(4):436-446.

Hecnar, Stephen J. 2009. Human bias and the biodiversity knowledge base: An examination of the published literature on vertebrates. Biodiversity 10(1):18-24.

Hero, Jean-Marc, Stephen E. Williams and William E. Magnusson. 2005. Ecological traits of declining amphibians in upland areas of eastern Australia. Journal of Zoology 267(3):221-232.

Hofmeyr, M.D., V.J.T. Loehr and E.H.W. Baard. 2018. *Chersobius signatus*, Speckled Dwarf Tortoise, THE IUCN RED LIST OF THREATENED SPECIES. November. https://www.researchgate.net/publication/330997239_Chersobius_signatus_Speckled_Dwarf_Tortoise_THE_IUCN_RED_LIST_OF_THREATENED_SPECIES. October 2019.

Hosgson, Blaine and Roberta Bencini. 2016. A study of the oblong turtle (*Chelodina colliei*) population of Hyde Park. September. https://www.researchgate.net/publication/322592776_A_study_of_the_oblong_turtle_Chelodina_colliei_population_of_Hyde_Park_Report_to_The_city_of_Vincent_Western_Australia. March 2020.

IUCN. 2001. Definitions of Extent of Occurence and Area of Occupancy. http://help.natureserve.org/biotics/Content/Record_Management/Element_Files/Element_Ranking/ERANK_Definitions_of_Extent_of_Occurrence_and_Area_of_Occupancy.htm. April 2020.

IUCN. 2019a. Caudata Stats. https://www.iucnredlist.org/search?taxonomies=100281&searchType=species. November 2019.

IUCN. 2019b. Primates Stats. https://www.iucnredlist.org/search?taxonomies=100091&searchType=species. November 2019.

IUCN. 2019c. Testudines Stats. https://www.iucnredlist.org/search?taxonomies=100224&searchType=species. November 2019.

IUCN. 2019d. Background & History. https://www.iucnredlist.org/about/background-history. October 2019.

IUCN. 2019e. IUCN Red List of Threatened Species. https://www.iucn.org/resources/conservation-tools/iucn-red-list-threatened-species. October 2019.

IUCN. 2019f. Red List. https://www.iucnredlist.org/search?taxonomies=100224&searchType=species. October 2019.

IUCN. 2020a. Northern Snake-necked Turtle. https://www.iucnredlist.org/species/4607/97260840. March 2020.

IUCN. 2020b. Testudines. March. https://www.iucnredlist.org/search?taxonomies=100224&searchType=species. March 2020.

IUCN. 2020c. Chaco Side-necked Turtle. https://www.iucnredlist.org/species/75/3139283. January 2020.

IUCN. 2020d. Southern River Terrapin. https://www.iucnredlist.org/species/170501/123816277. January 2020.

IUCN. 2020e. Roti Snake-necked Turtle. https://www.iucnredlist.org/species/123814489/123814575. February 2020.

IUCN. 2020f. Central American Snapping Turtle. https://www.iucnredlist.org/species/63660/97408221. March 2020.

IUCN. 2020g. Speckled Dwarf Tortoise. https://www.iucnredlist.org/species/10241/115650943. March 2020.

IUCN. 2020h. Senegal Flapshell Turtle. https://www.iucnredlist.org/species/6005/96447114. January 2020.

IUCN. 2020i. Hoge's Side-necked Turtle. https://www.iucnredlist.org/species/17081/1316719. January 2020.

IUCN. 2020j. Rio Grande Cooter. https://www.iucnredlist.org/species/18459/97425928. January 2020.

IUCN. 2020k. Peninsula Cooter. https://www.iucnredlist.org/species/170496/97427004. January 2020.

IUCN. 2020l. Ornate Slider. https://www.iucnredlist.org/species/63661/97430544. March 2020.

Iverson, John B. 1989. The Arizona Mud Turtle, *Kinosternon flavescens arizonense* (Kinosternidae), in Arizona and Sonora. The Southwestern Naturalist 34(3):356-368.

Iverson, John B. 1991. Patterns of survivorship in turtles (Odrer Testudines). Canadian Journal of Zoology 69(2):385-391.

Iverson, John B. 1992a. Correlates of Reproductive Output in Turtles (Order Testudines). Herpetological Monographs 6:25-42.

Iverson, John B. 1992b. A Revised Checklist with Distribution Maps of the Turtles of the World. Richmond, Indiana: John P. Iverson. 363 pp.

Iverson, John B., Christine P. Balgooyen, Kathy K. Byrd and Kelly K. Lyddan. 1993. Latitudinal variation in egg and clutch size in turtles. Canadian Journal of Zoology 71:2448-2461.

Jenkins, Martin D. 1995. Tortoises and Freshwater Turtles: The Trade in Southeast Asia. Cambridge: TRAFFIC International. 48 pp.

Kennett, Rod, Damien A. Fordham, Erica Alacs, Ben Corey and Arthur Georges. 2014. *Chelodina oblonga* Gray 1841 - Northern Snake-Necked Turtle. February. https://www.researchgate.net/publication/261604332_Chelodina_oblonga_Gray_1841_-_Northern_Snake-Necked_Turtle. March 2020.

Kennett, Rodney M., Arthur Georges, Ken Thomas and T.C. Georges. 1992. Distribution of the long-necked freshwater turtle *Chelodina novaeguineae* and new information on its ecology. Memoirs of the Queensland Museum 32(1):179-182.

Klemens, Michael W. 2000. Turtle Conservation. Smithsonian Institution Press. 334 pp.

Kumar, R. Suresh, Abishek Harihar and Bivash Pandav. 2009. A Natural History Account of the Tricarinate Hill-Turtle *Melanochelys tricarinata* in the Doon Valley, Northern India. January. https://www.researchgate.net/publication/234100402_A_natural_history_account_of_the_Tricarinate_Hill-Turtle_Melanochelys_tricarinata_in_the_Doon_Valley_Northern_India. March 2020.

Kusrini, Mirza D., Ani Mardiastuti, Mumpuni, Awal Riyanto, Sri M. Ginting and Badiah. 2014. Asiatic Soft-shell Turtle Amyda cartilaginea in Indonesia: A Review of its Natural History and Harvest. Journal of Indonesian Natural History 2(1):24-34.

Langley, Liz. 2018. What If There Were No More Turtles. https://www.nationalgeographic.com/animals/2018/09/turtles-endangered-biodiversity-ecology-tortoise-terrapin-animals/#close. November 2019.

Leenders, Twan. 2019. Reptiles of Costa Rica. Ithaca, New York: Cornell University Press. 628 pp.

Legler, John M. and John Cann. 1980. A new genus and species of chelid turtle from Queensland, Australia. Contributions to Science (Natural History Museum of

Los Angeles County) 324: 1-18. https://archive.org/details/biostor-232462/page/n11. January 2020.

Lesbarréres, D., S.L. Ashpole, C.A. Bishop, G. Blouin-Demers, R.J. Brooks, P. Echaubard, P. Govindarajulu, D.M. Green, S.J. Hecnar, T. Herman, J. Houlahan, J.D. Litzgus, M.J. Mazerolle, C.A. Paszkowski, P. Rutherford, D.M. Schock, K.B. Storey and S.C. Lougheed. 2014. Conservation of herptofauna in northern landscapes: Threats and challenges from a Canadian perspective. Biological Conservation 170:48-55.

Lindeman, Peter V. 2007. Diet, growth, body size, and reproductive potential of the Texas river cooter (*Pseudemys texana*) in the South Llano River, Texas. The Southwestern Naturalist 52(4):586-594.

Loehr, Victor J.T., Brian T. Henen and Margaretha D. Hofmeyr. 2004. Reproduction of the Smallest Tortoise, the Namaqualand Speckled Padloper, *Homopus signatus signatus*. Herpetologica 60(4):444-454.

Lovich, Jeff and Kathie Meyer. 2002. The western pond turtle (*Clemmys marmorata*) in the Mojave River, California, USA: highly adapted survivor or tenuous relict? Journal of Zoology 256(4):537-545.

Lovich, Jeffrey E., Joshua R. Ennen, Mickey Agha and J. Whitfield Gibbons. 2019. Where Have All the Turtles Gone, and Why Does It Matter? BioScience 68(10):771-781.

Maran, Jerome. 2002. Observations on Gabonese chelonians. https://www.lerefugedestortues.fr/publications/2002-turtles.pdf. January 2020.

Marques, Thiago S., Stephan Bohm, Elizangela S. Brito, Mario R. Cabrera and Luciano M. Verdade. 2014. *Mesoclemmys vanderhaegei* (Bour 1973) - Vanderhaege's Toad-headed Turtle, Karumbe-hy. December 27. http://zoocon.at/PDF/marques%20et%20al_2014.pdf. January 2020.

McCarthy, Donal. 2013. Costing Conservation. Significance 10(1):9-13.

McCord, William P. and Scott A. Thomson. 2002. A New Species of *Chelodina* (Testudines: Pleurodira: Chelidae) from Northern Australia. Journal of Herpetology 36(2):255-267.

Mocelin, Marcia A., Ronaldo Fernandes, Marcovan Porto and Daniel S. Fernandes. 2008. Reproductive Biology and Notes on Natural History of the Side-Necked Turtle *Acanthochelys radiolata* (Mikan, 1820) in Captivity (Testudines: Chelidae). South American Journal of Herpetology 3(3):223-228.

Morjan, Carrie L. and James N. Stuart. 2001. Nesting Record of a Big Bend Slider Turtle (*Trachemys gaigae*) in New Mexico, and Overwintering of Hatchlings in the Nest. The Southwestern Naturalist 46(2):230-234.

Mrosovsky, N. 1997. IUCN's credibility critically endangered. https://www.nature.com/articles/38873. November 2019.

NASA. 2020. Living Ocean. https://science.nasa.gov/earth-science/oceanography/living-ocean. April 2020.

Nelson, David H., Gabriel J. Langford, Joel A. Borden and William M. Turner. 2009. Reproductive and Hatchling Ecology of the Alabama Red-Bellied Cooter (*Pseudemys alabamensis*): Implications for Conservation and Management. Chelonian Conservation and Biology 8(1):66-73.

Neto, Habib J. Fraxe, Marcela Ayub Brasil, Gabriel de Freitas Horta, Thiago Oliveira Barros, Guth Berger Falcon and Guarino R. Colli. 2011. Demography of *Acanthochelys spixii* (Testudines, Chelidae) in the Brazilian Cerrado. Chelonian Conservation and Biology 10 (1):82-90.

Orenstein, Ronald. 2012. Turtles Tortoises and Terrapins: A Natural History. Richmond Hill: Firefly Books Ltd. 2012. 448 pp.

Palminteri, Suzanne, George Powell, Whaldener Endo, Chris Kirkby, Douglas Yu and Carlos A. Peres. 2011. Usefulness of species range polygons for predicting local primate occurences in southeastern Peru. American Journal of Primatology 73 (1): 53-61.

Pedrono, Miguel and Tim Markwell. 2001. Maximum Size and Mass of the Ploughshare Tortoise, *Geochelone yniphora*. Chelonian Conservation and Biology 4(1):190.

Pedrono, Miguel, Lora L. Smith, Augustin Sarovy, Robert Bourou, and Hafany Tiandray. 2001. Reproductive Ecology of the Ploughshare Tortoise (*Geochelone yniphora*). Journal of Herpetology 35(1):151-156.

Platt, Steven G., George R. Zug, Kalyar Platt, Win Ko Ko, Khin Myo Myo, Me Me Soe, Tint Lwin, et al. 2018. Field records of turtles, snakes and lizards in Myanmar (2009-2017) with natural history observations and notes on FOLK herpetological knowledge. Natural History Bulletin of the Siam Society 63(1):67-114.

Pough, F. Harvey, Robin M. Andrews, Martha L. Crump, Alan H. Savitzky, Kentwood D. Wells and Matthew C. Brandley. 2018. Herpetology: Fourth Edition. Sunderland, Massachusetts: Oxford University Press. 591 pp.

Powell, Robert, Roger Conant and Joseph T. Collins. 2016. Peterson Field Guide to Reptiles and Amphibians of Eastern and Central North America: Fourth Edition. New York: Houghton Mifflin Harcourt Publishing Company. 494 pp.

Praschag, Peter, Anna K. Hundsdoerfer and Uwe Fritz. 2009. Further specimens and phylogenetic position of the recently described leaf turtle species *Cyclemys gemeli* (Testudines: Geoemydidae). Zootaxa. https://www.mapress.com/j/zt/article/view/zootaxa.2008.1.3/27741. January 2020.

Ramesh, Vijay. 2017. Inaccurate IUCN range maps leave birds endemic to India's western Ghats vulnerable. https://www.eurekalert.org/pub_releases/2017-04/cioe-iir041817.php. April 2020.

Rhodin, Anders G. J. 1994. Chelid turtles of the Australasian Archipelago: II. A new species of *Chelodina* from Roti Island, Indonesia. Breviora: Museum of Comparative Zoology. 497. https://iucn-tftsg.org/wp-content/uploads/file/Articles/Rhodin_1994a(1).pdf. January 2020.

Rhodin, Anders G.J., Andrew D. Walde, Brian D. Horne, Peter Paul Van Dijk, Torsten Blanck and Rick Hudson. 2011. Turtle in Trouble: The World's 25+ Most Endangered Tortoises and Freshwater Turtles - 2011.

Rhodin, Anders G.J., Craig B. Stanford, Peter Paul Van Dijk, Carla Eisemberg, Luca Luiselli, Russell A. Mittermeier, Rick Hudson, Brian D. Horne, Eric V. Goode, Gerald Kuchling, Andrew Walde, Ernst H.W. Baard, Kristin H. Berry and Albe Bertolero. 2018. Global Conservation Status of Turtles and Tortoises (Order Testudines). Chelonian Conservation and Biology 17(2):135-161.

Rhodin, Anders G.J., John B. Iverson, Roger Bour, Uwe Fritz, Arthur Georges, H. Bradley Shaffer and Peter Paul van Dijk. 2017. Turtles of the World: Annotated Checklist and Atlas of Taxonomy, Synonymy, Distribution, and Conservation Status (8th Ed.). Chelonian Research Foundation and Turtle Conservancy. 292 pp.

Rodrigues, Ana S.L., John D. Pilgrim, John F. Lamoreux, Michael Hoffmann and Thomas M. Brooks. 2006. The value of the IUCN Red List for conservation. Trends in Ecology & Evolution 21(2):71-76.

Runge, Claire A., Ayesha Tulloch, Edd Hammill, Hugh P. Possingham and Richard A. Fuller. 2015. Geographic range size and extinction risk assessment in nomadic species. Conservation Biology 29(3):865-876.

Santana, Daniel O., Thiago S. Marques, Gustavo H.C. Vieira, Geraldo J.B. Moura, Renato G. Faria and Daniel O. Mesquita. 2016. *Mesoclemmys tuberculata* (Luederwaldt 1926) - Tuberculate Toad-headed Turtle. October 26. https://www.researchgate.net/publication/309431146_Mesoclemmys_tuberculata_Luederwaldt_1926_-_Tuberculate_Toad-headed_Turtle. January 2020.

Scoch, Rainer R., Nicole Klein, Torsten Scheyer and Hans-Dieter Sues. 2019. Microanatomy of the stem-turtle Pappochelys rosinae indicastes a predominantly fossorial mode of life and clarifies early steps in the evolution of the shell. Nature. July 18. https://www.nature.com/articles/s41598-019-46762-z.pdf. October 2019.

Seateun, Sengvilay, Nancy E. Karraker, Bryan L. Stuart and Anchalee Aowphol. 2019. Population demography of Oldham's leaf turtle (*Cyclemys oldhamii*) in protected and distributed habitats in Thailand. PeerJ. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6611445/. Janury 2020.

Seddon, Philip J., Pritpal S. Soorae and Frederic Launay. 2005. Taxonomic bias in reintroduction projects. Animal Conservation 8(1):51-58.

Shine, Richard. 1983. Reptilian Reproductive Modes: The Oviparity-Viviparity Continuum. Herpetologica 39(1):1-8.

Shine, Richard and John B. Iverson. 1995. Patterns of survival, growth and maturation in turtles. Oikos 72(3):343-348.

Siliceo, Ignacio and Jose A. Diaz. 2010. A comparative study of clutch size, range size, and the conservation status of island vs. mainland lacertid lizards. Biological Conservation 143:2601-2608.

Spawls, Stephen, Kim Howell, Harald Hinkel and Michele Menegon. 2018. Field Guide to East African Reptiles. New York: Bloomsbury Wildlife.

Speybroeck, Jeroen, Wouter Beukema, Bobby Bok and Jan Van Der Voort. 2016. Field Guide to the Amphibians & Reptiles of Britain and Europe. New York: Bloomsbury Publishing Plc. 432 pp.

Stamper, M. Andrew, Chad W. Spicer, Donald L. Neiffer, Kristin S. Mathews and Gregory J. Fleming. 2009. Morbidity in a Juvenile Green Sea Turtle (*Chelonia mydas*) Due to Ocean-Borne Plastic. Journal of Zoo and Wildlife Medicine 40(1):196-198.

Stanford, Craig B., Anders G.J. Rhodin, Peter Paul van Dijk, Brian D. Horne, Torsten Blanck, Eric V. Goode, Rick Hudson, Russell A. Mittermeier, Andrea Currylow, Carla Eisemberg, Matthew Frankel, Arthur Georges, Paul M. Gibbons and James O. Juvik. 2018. Turtles in Trouble: The World's 25+ Most Endangered Tortoises and Freshwater Turtles - 2018.

Stevens, G.C. 1989. The latitudinal gradients in geographic range: how so many species can coexist in the tropics. American Naturalist 132:240-256.

Thomson, Scott and Arthur Georges. 2016. A new species of freshwater turtle of the genus *Elseya* (Testudinata: Pleurodira: Chelidae) from the Northern Territory of Australia. Zootaxa https://pdfs.semanticscholar.org/be2f/6cafd11a3cd9830161c239462500156a64b6.pdf. January 2020.

Thomson, Scott, Arthur Georges and Colin J. Limpus. 2006. A New Species of Freshwater Turtle in the Genus *Elseya* (Testudines: Chelidae) from Central Coastal Queensland, Australia. Chelonian Conservation and Biology 5(1):74-86.

UNEP-WCMC, IUCN and NGS. 2018. Protected Planet Report 2018. https://livereport.protectedplanet.net/pdf/Protected_Planet_Report_2018.pdf. April 2020.

USGS. 2018. Nonindigenous Aquatic Species. https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=1264. March 2020.

Vogt, Richard C. 2008. Amazon Turtles. Wust Editions. 104 pp.

Wick, Ian. 2012. Virgil The Turtle. Williston.

WWF. 2020. How Long do Sea Turtles Live? And Other Sea Turtle Facts. https://www.worldwildlife.org/stories/how-long-do-sea-turtles-live-and-other-sea-turtle-facts. April 2020.

Wyneken, Jeanette, Matthew H. Godfrey and Vincent Bels. 2008. Biology of Turtles. New York: CRC Press. 408 pp.

Zuffi, M. A., F. Odetti and P. Meozzi. 1999. Body size and clutch size in the European pond turtle (*Emys orbicularis*) from central Italy. Journal of Zoology 247(2):139-143.

Zug, George R. 2013. Reptiles and Amphibians of the Pacific Islands: A Comprehensive Guide. London: University of California Press. 305 pp.

Zug, George R. 2019. Turtle. https://www.britannica.com/animal/turtle-reptile. October 2019.

APPENDIX

APPENDIX I

Table 6. Attribute data for 357 species of turtles (Note: PT = Population Trend, Range = Geographical Range Size (km^2), Midpoint = Midpoint Latitude (◦), CS = Mean Clutch Size, CL = Mean Female Carapace Length (mm)).

Scientific Name	Suborder	Family	Global IUCN Status	PT	Range	Midpoint	CS	CL	Sources
Acanthochelys macrocephala	Pleurodira	Chelidae	Near Threatened	Decreasing	448346.8811	-19.591839	6		(Iverson 1992b; Hecnar 1999b; Mocelin *et al.* 2008; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Acanthochelys pallidipectoris	Pleurodira	Chelidae	Endangered	Decreasing	245148.6108	-25.97381	3.5	144	(Rhodin *et al.* 2017; Google 2019; IUCN 2019f; IUCN 2020c)
Acanthochelys radiolata	Pleurodira	Chelidae	Near Threatened	Unspecified	218949.2576	-15.872541	3	165	(Mocelin *et al.* 2008; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Acanthochelys spixii	Pleurodira	Chelidae	Near Threatened	Unspecified	419440.2731	-24.473112	4	139.78	(Mocelin *et al.* 2008; Neto *et al.* 2011; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Actinemys marmorata	Cryptodira	Emydidae	Vulnerable	Unspecified	322550.9905	42.706168	4.65	145.75	(Iverson 1992b; Iverson *et al.* 1993; Hecnar 1999b; Germano and Riedle 2015; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Actinemys pallida	Cryptodira	Emydidae	Vulnerable	Unspecified	85408.86535	33.781446	4.46	144	(Lovich and Meyer 2002; Rhodin *et al.* 2017; Cummings *et al.* 2018; Google 2019)
Amyda cartilaginea	Cryptodira	Trionychidae	Vulnerable	Unspecified	1015790.054	0.263773	19.875		(Kusrini 2015; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Amyda ornata	Cryptodira	Trionychidae	Vulnerable	Unspecified	921208.9425	17.994226			(Rhodin *et al.* 2017; Google 2019)
Apalone ferox	Cryptodira	Trionychidae	Least Concern	Unknown	296126.3952	29.24447	20.04	339.3	(Iverson 1992b; Iverson *et al.* 1993; Hecnar 1999b; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Apalone mutica	Cryptodira	Trionychidae	Least Concern	Unknown	1230399.945	38.099586	13.57	211	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Apalone spinifera	Cryptodira	Trionychidae	Least Concern	Stable	2919573.137	38.121094	25.315	372.5	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Astrochelys radiata	Cryptodira	Testudinidae	Critically Endangered	Decreasing	17302.94103	-24.406753	8.93	336.6	(Iverson 1992b; Iverson *et al.* 1993; Hecnar 1999b; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Astrochelys yniphora	Cryptodira	Testudinidae	Critically Endangered	Decreasing	1005.568986	-16.106108	3.555	370.1	(Iverson 1992b; Hecnar 1999b; Pedrono *et al.* 2001; Pedrono and Markwell 2001; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Batagur affinis	Cryptodira	Geoemydidae	Critically Endangered	Decreasing	150319.8329	3.844432	26	525	(Rhodin *et al.* 2017; Google 2019; IUCN 2019f; IUCN 2020d)
Batagur baska	Cryptodira	Geoemydidae	Critically Endangered	Decreasing	158561.326	17.03779	24.39	488	(Iverson *et al.* 1993; Jenkins 1995; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Batagur borneoensis	Cryptodira	Geoemydidae	Critically Endangered	Unspecified	320769.5722	1.902391	12.49	466	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Batagur dhongoka	Cryptodira	Geoemydidae	Critically Endangered	Decreasing	513488.3981	25.777057	26.165	420	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Batagur kachuga	Cryptodira	Geoemydidae	Critically Endangered	Decreasing	283040.5921	25.618661	17	560	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Batagur trivittata	Cryptodira	Geoemydidae	Critically Endangered	Decreasing	123367.2168	21.014693	25		(Furtado 1988; Jenkins 1995; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Caretta caretta	Cryptodira	Cheloniidae	Vulnerable	Decreasing	63472091.39	4.252266	117	859	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Carettochelys insculpta	Cryptodira	Carettochelyidae	Endangered	Decreasing	435328.8801	-11.253778	15	457	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Pough *et al.* 2018; Google 2019; IUCN 2019f)
Centrochelys sulcata	Cryptodira	Testudinidae	Vulnerable	Unspecified	3150200.929	15.631379	17	510	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Chelodina burrungandjii	Pleurodira	Chelidae	Not Listed	N/A	39296.25574	-13.358267			(Rhodin *et al.* 2017; Google 2019)
Chelodina canni	Pleurodira	Chelidae	Not Listed	N/A	402361.9655	-17.609859	10	193	(Kennett *et al.* 1992; Iverson *et al.* 1993; McCord and Thomson 2002; Rhodin *et al.* 2017; Google 2019)
Chelodina colliei	Pleurodira	Chelidae	Near Threatened	Unspecified	96890.30002	-32.695482	6	239.3	(Hosgson and Bencini 2016; Rhodin *et al.* 2017; Google 2019; Government of Western Australia 2020; IUCN 2020a)
Chelodina expansa	Pleurodira	Chelidae	Not Listed	N/A	365025.6856	-29.812686	20.1667	362	(Iverson 1992b; Iverson *et al.* 1993; Booth 1998; Hecnar 1999b; Bower and Hodges 2014; Rhodin *et al.* 2017; Google 2019)
Chelodina gunaleni	Pleurodira	Chelidae	Not Listed	N/A	22743.99972	-5.047031			(Rhodin *et al.* 2017; Google 2019)
Chelodina kuchlingi	Pleurodira	Chelidae	Not Listed	N/A	13938.1636	-14.828699			(Rhodin *et al.* 2017; Google 2019)
Chelodina longicollis	Pleurodira	Chelidae	Not Listed	N/A	1547543.85	-29.488503	13.9	233	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019)
Chelodina mccordi	Pleurodira	Chelidae	Critically Endangered	Decreasing	1863.042104	-9.664251	9.5333		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f; IUCN 2020e)
Chelodina novaeguineae	Pleurodira	Chelidae	Least Concern	Unspecified	82879.07209	-7.469683	14.75		(Ernst and Barbour 1989; Rhodin 1994; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Chelodina oblonga	Pleurodira	Chelidae	Near Threatened	Unspecified	85025.06039	-13.229964	10.5	230	(Iverson 1992b; Iverson *et al.* 1993; Hecnar 1999b; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Chelodina parkeri	Pleurodira	Chelidae	Vulnerable	Unspecified	41245.12994	-7.379536		220	(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Chelodina pritchardi	Pleurodira	Chelidae	Endangered	Unspecified	7105.455106	-9.509652			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Chelodina reimanni	Pleurodira	Chelidae	Near Threatened	Unspecified	50402.42747	-7.722873	12.99		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Chelodina steindachneri	Pleurodira	Chelidae	Not Listed	N/A	561642.2713	-24.777398			(Rhodin *et al.* 2017; Google 2019)
Chelodina walloyarrina	Pleurodira	Chelidae	Not Listed	N/A	99431.74758	-16.141519			(Rhodin *et al.* 2017; Google 2019)
Chelonia mydas	Cryptodira	Cheloniidae	Endangered	Decreasing	190288146.5	4.241584	101.65	872.67	(Iverson *et al.* 1993; Chen and Chang 1995; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Chelonoidis abingdonii	Cryptodira	Testudinidae	Extinct	Unspecified	31.57	0.56874		680	(Zug 2013; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Chelonoidis becki	Cryptodira	Testudinidae	Vulnerable	Unknown	225.49	0.028956			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Chelonoidis carbonarius	Cryptodira	Testudinidae	Not Listed	N/A	4410390.715	-6.967653	4	289	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019)
Chelonoidis chathamensis	Cryptodira	Testudinidae	Endangered	Increasing	216.3	-0.804992	5		(Zug 2013; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Chelonoidis chilensis	Cryptodira	Testudinidae	Vulnerable	Unspecified	930928.0412	-31.460861	4.07	283	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Chelonoidis darwini	Cryptodira	Testudinidae	Critically Endangered	Increasing	174.07	-0.272162	7		(Zug 2013; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Chelonoidis denticulata	Cryptodira	Testudinidae	Vulnerable	Unspecified	6072026.292	-5.477871	6	317.3	(Ernst and Barbour 1989; Iverson 1992; Hecnar 1999b; Bohm 2011; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Chelonoidis donfaustoi	Cryptodira	Testudinidae	Critically Endangered	Increasing	115.92	-0.653057			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Chelonoidis duncanensis	Cryptodira	Testudinidae	Vulnerable	Increasing	13.09	-0.624612	5	570	(Zug 2013; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Chelonoidis guntheri	Cryptodira	Testudinidae	Critically Endangered	Unknown	465.1918416	-0.876101	9	670	(Zug 2013; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Chelonoidis hoodensis	Cryptodira	Testudinidae	Critically Endangered	Increasing	38.36	-1.384919	5		(Zug 2013; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Chelonoidis microphyes	Cryptodira	Testudinidae	Endangered	Unknown	115.69	-0.229839	9	640	(Zug 2013; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Chelonoidis niger	Cryptodira	Testudinidae	Extinct	Unspecified	48.44	-1.253821			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)

Table 6 (continued). Attribute data for 357 species of turtles (Note: PT = Population Trend, Range = Geographical Range Size (km^2), Midpoint = Midpoint Latitude (◦), CS = Mean Clutch Size, CL = Mean Female Carapace Length (mm)).

Scientific Name	Suborder	Family	Global IUCN Status	PT	Range	Midpoint	CS	CL	Sources
Chelonoidis phantasticus	Cryptodira	Testudinidae	Critically Endangered	Unknown	76.65471074	-0.417862			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Chelonoidis porteri	Cryptodira	Testudinidae	Critically Endangered	Increasing	250.4739606	-0.698153	9.5		(Ernst and Barbour 1989; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Chelonoidis vandenburghi	Cryptodira	Testudinidae	Vulnerable	Increasing	483.8236072	-0.438676			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Chelonoidis vicina	Cryptodira	Testudinidae	Endangered	Unknown	341.7947669	-0.947902	9		(Ernst and Barbour 1989; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Chelus fimbriata	Pleurodira	Chelidae	Not Listed	N/A	2904438.402	-3.158025	12	275	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019)
Chelydra acutirostris	Cryptodira	Chelydridae	Not Listed	N/A	464115.2138	6.94193	30		(Rhodin *et al.* 2017; Google 2019; Leenders 2019)
Chelydra rossignonii	Cryptodira	Chelydridae	Vulnerable	Unknown	167173.5135	16.945526	25		(Rhodin *et al.* 2017; Google 2019; IUCN 2019f; IUCN 2020f)
Chelydra serpentina	Cryptodira	Chelydridae	Least Concern	Stable	4753001.029	39.996143	29.4225	255.37	(Iverson *et al.* 1993; Rhodin 2017; CITES 2018; Google 2019; IUCN 2019f)
Chersina angulata	Cryptodira	Testudinidae	Least Concern	Stable	382999.0562	-30.715079	1.345	158	(Iverson 1992b; Iverson *et al.* 1993; Hecnar 1999b; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Chersobius boulengeri	Cryptodira	Testudinidae	Endangered	Decreasing	144403.8143	-32.274488	1	100	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Chersobius signatus	Cryptodira	Testudinidae	Endangered	Decreasing	70640.83096	-30.617205	1	86.8	(Loehr *et al.* 2004; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f; IUCN 2020g)
Chersobius solus	Cryptodira	Testudinidae	Vulnerable	Unspecified	26359.88129	-27.123214			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Chitra chitra	Cryptodira	Trionychidae	Critically Endangered	Decreasing	308025.1309	3.892459			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Chitra indica	Cryptodira	Trionychidae	Endangered	Unspecified	1185555.306	21.939712	101.715	1110	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Chitra vandijki	Cryptodira	Trionychidae	Not Listed	N/A	125547.0826	20.973012			(Rhodin *et al.* 2017; Google 2019)
Chrysemys dorsalis	Cryptodira	Emydidae	Least Concern	Stable	332469.3756	33.27097	4.5	112.5	(Ernst and Barbour 1989; Powell *et al.* 2016; Rhodin *et al.* 2017; Google 2019)
Chrysemys picta	Cryptodira	Emydidae	Least Concern	Stable	4672592.596	43.451549	7.6625	149.125	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Claudius angustatus	Cryptodira	Staurotypidae	Near Threatened	Unspecified	150235.0628	17.820183	4	104	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Clemmys guttata	Cryptodira	Emydidae	Endangered	Decreasing	1149992.932	38.041667	4.19	102.5	(Iverson *et al.* 1993; Powell *et al.* 2016; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Cuora amboinensis	Cryptodira	Geoemydidae	Vulnerable	Unspecified	3563737.757	9.338949	1.5	175	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Cuora aurocapitata	Cryptodira	Geoemydidae	Critically Endangered	Unspecified	34223.76687	30.929003	3		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Cuora bourreti	Cryptodira	Geoemydidae	Critically Endangered	Decreasing	41377.52074	15.237455	1.67		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Cuora cyclornata	Cryptodira	Geoemydidae	Critically Endangered	Unspecified	162254.3951	18.816265			(Rhodin *et al.* 2017; Google 2019)
Cuora flavomarginata	Cryptodira	Geoemydidae	Endangered	Unspecified	498587.1674	27.652792	1.8	152	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Cuora galbinifrons	Cryptodira	Geoemydidae	Critically Endangered	Decreasing	130555.8832	20.105884	2		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Cuora mccordi	Cryptodira	Geoemydidae	Critically Endangered	Unspecified	25500.86549	23.330565	1.5	137.1	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Cuora mouhotii	Cryptodira	Geoemydidae	Endangered	Unspecified	720387.7556	20.229636	2.5		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Cuora pani	Cryptodira	Geoemydidae	Critically Endangered	Unspecified	93868.93795	32.262434			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Cuora picturata	Cryptodira	Geoemydidae	Critically Endangered	Decreasing	7610.906759	12.59039	2		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Cuora trifasciata	Cryptodira	Geoemydidae	Critically Endangered	Unspecified	255004.6304	21.946521	2		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Cuora yunnanensis	Cryptodira	Geoemydidae	Critically Endangered	Decreasing	35254.26867	26.360778	8		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Cuora zhoui	Cryptodira	Geoemydidae	Critically Endangered	Unspecified	16087.16225	22.926434			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Cyclanorbis elegans	Cryptodira	Trionychidae	Critically Endangered	Decreasing	621347.1744	9.960505	27		(Rhodin *et al.* 2017; Demaya *et al.* 2019; Google 2019; IUCN 2019f)
Cyclanorbis senegalensis	Cryptodira	Trionychidae	Vulnerable	Decreasing	3055567.965	10.760232	15.5		(Rhodin *et al.* 2017; Google 2019; IUCN 2019f; IUCN 2020h)
Cyclemys atripons	Cryptodira	Geoemydidae	Not Listed	N/A	28315.5264	11.833386			(Rhodin *et al.* 2017; Google 2019)
Cyclemys dentata	Cryptodira	Geoemydidae	Near Threatened	Unspecified	1452889.416	1.810697	2.89	200	(Furtado 1988; Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Cyclemys enigmatica	Cryptodira	Geoemydidae	Not Listed	N/A	895497.2068	0.206994			(Rhodin *et al.* 2017; Google 2019)
Cyclemys fusca	Cryptodira	Geoemydidae	Not Listed	N/A	332930.1705	22.784701			(Rhodin *et al.* 2017; Google 2019)
Cyclemys gemeli	Cryptodira	Geoemydidae	Not Listed	N/A	280127.438	24.430557		223.5	(Praschag *et al.* 2009; Rhodin *et al.* 2017; Google 2019)
Cyclemys oldhamii	Cryptodira	Geoemydidae	Not Listed	N/A	877102.7048	15.234805	3	182	(Aryal *et al.* 2010; Rhodin *et al.* 2017; Google 2019; Seateun *et al.* 2019)
Cyclemys pulchristriata	Cryptodira	Geoemydidae	Not Listed	N/A	79960.17286	13.759032			(Rhodin *et al.* 2017; Google 2019)
Cycloderma aubryi	Cryptodira	Trionychidae	Vulnerable	Decreasing	757029.6439	-0.811129	24.5		(Maran 2002; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Cycloderma frenatum	Cryptodira	Trionychidae	Endangered	Decreasing	463969.5487	-14.445755	18.5	560	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Cylindraspis indica	Cryptodira	Testudinidae	Extinct	Unspecified	2448.38	-21.135312			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Cylindraspis inepta	Cryptodira	Testudinidae	Extinct	Unspecified	1825.03	-20.289053			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Cylindraspis peltastes	Cryptodira	Testudinidae	Extinct	Unspecified	108.09	-19.713362			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Cylindraspis triserrata	Cryptodira	Testudinidae	Extinct	Unspecified	1825.03	-20.289053			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Cylindraspis vosmaeri	Cryptodira	Testudinidae	Extinct	Unspecified	108.09	-19.713362			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Deirochelys reticularia	Cryptodira	Emydidae	Not Listed	N/A	892781.4137	31.266511	8.75	185.8	(Iverson 1992b; Iverson *et al.* 1993; Hecnar 1999b; Rhodin *et al.* 2017; Google 2019)
Dermatemys mawii	Cryptodira	Dermatemydidae	Critically Endangered	Decreasing	137220.8014	17.319978	17.855	470	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Dermochelys coriacea	Cryptodira	Dermochelyidae	Vulnerable	Decreasing	86080918.59	7.875652	79.8	1470	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)

Table 6 (continued). Attribute data for 357 species of turtles (Note: PT = Population Trend, Range = Geographical Range Size (km^2), Midpoint = Midpoint Latitude (◦), CS = Mean Clutch Size, CL = Mean Female Carapace Length (mm)).

Scientific Name	Suborder	Family	Global IUCN Status	PT	Range	Midpoint	CS	CL	Sources
Dogania subplana	Cryptodira	Trionychidae	Least Concern	Unspecified	1332399.318	2.971593	5		(CITES 2013; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Elseya albagula	Pleurodira	Chelidae	Not Listed	N/A	141438.4254	-24.697889	14	305.152	(Thomson *et al.* 2006; Thomson and Georges 2016; Rhodin *et al.* 2017; Google 2019)
Elseya bellii	Pleurodira	Chelidae	Endangered	Unspecified	20421.8008	-29.921514	18.3		(Fielder *et al.* 2015; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Elseya branderhorsti	Pleurodira	Chelidae	Vulnerable	Unspecified	169667.5272	-7.488476	23.5		(Georges *et al.* 2006; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Elseya dentata	Pleurodira	Chelidae	Not Listed	N/A	175553.0351	-15.866946	5	343	(Legler and Cann 1980; Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019)
Elseya flaviventralis	Pleurodira	Chelidae	Not Listed	N/A	160321.8328	-13.945441			(Rhodin *et al.* 2017; Google 2019)
Elseya georgesi	Pleurodira	Chelidae	Data Deficient	Unspecified	1143.594997	-30.510118	12.5		(Cann 1997a; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Elseya irwini	Pleurodira	Chelidae	Not Listed	N/A	11507.54811	-19.108534	12		(Cann 1997b; Rhodin *et al.* 2017; Google 2019)
Elseya lavarackorum	Pleurodira	Chelidae	Not Listed	N/A	40759.788	-17.96667	7.5	302.1	(Freeman *et al.* 2014; Rhodin *et al.* 2017; Google 2019)
Elseya novaeguineae	Pleurodira	Chelidae	Least Concern	Unspecified	780905.913	-2.084928	12		(Iverson 1992b; Hecnar 1999b; Georges *et al.* 2006; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Elseya purvisi	Pleurodira	Chelidae	Data Deficient	Unspecified	2961.389178	-31.583117			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Elseya rhodini	Pleurodira	Chelidae	Not Listed	N/A	288244.4047	-6.765692			(Rhodin *et al.* 2017; Google 2019)
Elseya schultzei	Pleurodira	Chelidae	Not Listed	N/A	191554.8259	-5.170434			(Rhodin *et al.* 2017; Google 2019)
Elusor macrurus	Pleurodira	Chelidae	Endangered	Unspecified	11066.02155	-26.011024	14.5		(Cann and Legler 1994; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Emydoidea blandingii	Cryptodira	Emydidae	Endangered	Decreasing	822599.3505	43.119686	12	201.9	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Emydura macquarii	Pleurodira	Chelidae	Not Listed	N/A	919313.0282	-26.259173	13.59	237	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019)
Emydura subglobosa	Pleurodira	Chelidae	Least Concern	Unspecified	443808.4148	-12.665685	8	210	(Iverson *et al.* 1993; Georges *et al.* 2006; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Emydura tanybaraga	Pleurodira	Chelidae	Not Listed	N/A	177068.5376	-14.282904	16		(Green 2014; Rhodin *et al.* 2017; Google 2019)
Emydura victoriae	Pleurodira	Chelidae	Not Listed	N/A	192050.609	-15.732669	10		(Gaikhorst *et al.* 2011; Rhodin *et al.* 2017; Google 2019)
Emys orbicularis	Cryptodira	Emydidae	Near Threatened	Unspecified	4159281.65	45.567738	9		(Zuffi *et al.* 1999; Speybroeck *et al.* 2016; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Emys trinacris	Cryptodira	Emydidae	Data Deficient	Unknown	17170.38613	37.455303			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Eretmochelys imbricata	Cryptodira	Cheloniidae	Critically Endangered	Decreasing	43884542.71	-4.535115	142.93	820	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Erymnochelys madagascariensis	Pleurodira	Podocnemididae	Critically Endangered	Decreasing	154212.9886	-18.768993	19.8		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Geochelone elegans	Cryptodira	Testudinidae	Vulnerable	Decreasing	915868.1916	16.750981	5.39		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Geochelone gigantea	Cryptodira	Testudinidae	Vulnerable	Unspecified	350.24	-9.408341	9.65		(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Geochelone platynota	Cryptodira	Testudinidae	Critically Endangered	Unspecified	88243.25193	21.779138	5.39		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Geoclemys hamiltonii	Cryptodira	Geoemydidae	Endangered	Decreasing	1079456.342	27.155367	15.5		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Geoemyda japonica	Cryptodira	Geoemydidae	Endangered	Unspecified	2880.270126	26.496052	1.67		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Geoemyda spengleri	Cryptodira	Geoemydidae	Endangered	Unspecified	345333.2805	20.924741	1.335	101	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Glyptemys insculpta	Cryptodira	Emydidae	Endangered	Decreasing	1046695.49	43.143739	10.265	198.3	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Glyptemys muhlenbergii	Cryptodira	Emydidae	Critically Endangered	Unknown	86382.79076	39.226568	3.65	91.82	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Gopherus agassizii	Cryptodira	Testudinidae	Vulnerable	Unspecified	129429.2795	36.977928	5.665	220	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Gopherus berlandieri	Cryptodira	Testudinidae	Least Concern	Unspecified	213898.2507	25.845486	3.16	169	(Iverson 1992b; Iverson *et al.* 1993; Hecnar 1999b; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Gopherus evgoodei	Cryptodira	Testudinidae	Vulnerable	Decreasing	42855.89729	27.280223			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Gopherus flavomarginatus	Cryptodira	Testudinidae	Critically Endangered	Decreasing	13131.22157	27.117308	5.57		(Iverson 1992b; Hecnar 1999; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Gopherus morafkai	Cryptodira	Testudinidae	Not Listed	N/A	209975.5548	31.46279			(Rhodin *et al.* 2017; Google 2019)
Gopherus polyphemus	Cryptodira	Testudinidae	Vulnerable	Unspecified	190834.9299	29.216133	6	268.2	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Graptemys barbouri	Cryptodira	Emydidae	Vulnerable	Decreasing	37823.63592	31.647536	8.555	220	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Graptemys caglei	Cryptodira	Emydidae	Endangered	Decreasing	10159.18853	29.465651	3.5		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Graptemys ernsti	Cryptodira	Emydidae	Near Threatened	Decreasing	12978.6986	31.207754	8.67		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Graptemys flavimaculata	Cryptodira	Emydidae	Vulnerable	Decreasing	9250.577022	31.310554	7.81	140	(Powell *et al.* 2016; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Graptemys geographica	Cryptodira	Emydidae	Least Concern	Stable	1214525.73	40.38447	11.42	226	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Graptemys gibbonsi	Cryptodira	Emydidae	Endangered	Decreasing	12278.27517	31.471871	5.66		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Graptemys nigrinoda	Cryptodira	Emydidae	Least Concern	Stable	60072.83353	32.729285	6.275	155	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Graptemys oculifera	Cryptodira	Emydidae	Vulnerable	Unknown	18835.02294	31.697544	5.885	148	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Graptemys ouachitensis	Cryptodira	Emydidae	Least Concern	Stable	686495.653	37.759628	10.52	205	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Graptemys pearlensis	Cryptodira	Emydidae	Endangered	Decreasing	12127.30608	31.547863	6.4		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Graptemys pseudogeographica	Cryptodira	Emydidae	Least Concern	Unknown	1036721.25	38.948502	12.305	225	(Iverson 1992b; Iverson *et al.* 1993; Hecnar 1999b; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Graptemys pulchra	Cryptodira	Emydidae	Near Threatened	Unknown	55079.43756	32.844736	6.295	247	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Graptemys sabinensis	Cryptodira	Emydidae	Least Concern	Stable	36238.06947	31.428414			(Rhodin *et al.* 2017; Google 2019)
Graptemys versa	Cryptodira	Emydidae	Least Concern	Stable	16815.26751	30.498133	9.52	157	(Iverson 1992b; Hecnar 1999b; Powell *et al.* 2016; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)

Table 6 (continued). Attribute data for 357 species of turtles (Note: PT = Population Trend, Range = Geographical Range Size (km^2), Midpoint = Midpoint Latitude (◦), CS = Mean Clutch Size, CL = Mean Female Carapace Length (mm)).

Scientific Name	Suborder	Family	Global IUCN Status	PT	Range	Midpoint	CS	CL	Sources
Hardella thurjii	Cryptodira	Geoemydidae	Vulnerable	Unspecified	531644.2694	26.597598	14		(Aryal *et al.* 2010; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Heosemys annandalii	Cryptodira	Geoemydidae	Endangered	Unspecified	353915.4404	11.61644			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Heosemys depressa	Cryptodira	Geoemydidae	Critically Endangered	Unspecified	52011.91138	19.786588			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Heosemys grandis	Cryptodira	Geoemydidae	Vulnerable	Unspecified	607561.3016	10.341112	6		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Heosemys spinosa	Cryptodira	Geoemydidae	Endangered	Unspecified	999063.276	4.247088	1.165	186	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Homopus areolatus	Cryptodira	Testudinidae	Least Concern	Decreasing	137044.7414	-32.865133	2.815	110.5	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Homopus femoralis	Cryptodira	Testudinidae	Least Concern	Unknown	226354.7975	-30.086834	1.725	140	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Hydromedusa maximiliani	Pleurodira	Chelidae	Vulnerable	Unspecified	118411.5023	-22.134069			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Hydromedusa tectifera	Pleurodira	Chelidae	Not Listed	N/A	993673.1138	-27.788139			(Rhodin *et al.* 2017; Google 2019)
Indotestudo elongata	Cryptodira	Testudinidae	Critically Endangered	Decreasing	2034295.048	18.216561	3.905	260	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Indotestudo forstenii	Cryptodira	Testudinidae	Endangered	Unspecified	46107.7129	-0.190635	3.16	138.9	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Indotestudo travancorica	Cryptodira	Testudinidae	Vulnerable	Unspecified	46637.74953	11.960558	3.54		(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Kinixys belliana	Cryptodira	Testudinidae	Not Listed	N/A	3511150.08	0.203455	2.535	180	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019)
Kinixys erosa	Cryptodira	Testudinidae	Data Deficient	Unspecified	3235985.526	0.336668	2.5		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Kinixys homeana	Cryptodira	Testudinidae	Vulnerable	Decreasing	810990.1839	3.188019	3		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Kinixys lobatsiana	Cryptodira	Testudinidae	Vulnerable	Decreasing	78575.62722	-25.019486	2.77		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Kinixys natalensis	Cryptodira	Testudinidae	Vulnerable	Decreasing	74817.11858	-26.814129	2.77		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Kinixys nogueyi	Cryptodira	Testudinidae	Not Listed	N/A	2034681.068	9.445458	2.77		(Rhodin *et al.* 2017; CITES 2018; Google 2019)
Kinixys spekii	Cryptodira	Testudinidae	Not Listed	N/A	2067674.296	-13.963863	3.5		(Rhodin *et al.* 2017; CITES 2018; Google 2019)
Kinixys zombensis	Cryptodira	Testudinidae	Not Listed	N/A	608327.6559	-16.233215	2.77		(Rhodin *et al.* 2017; CITES 2018; Google 2019)
Kinosternon abaxillare	Cryptodira	Kinosternidae	Not Listed	N/A	20850.02137	16.102395			(Rhodin *et al.* 2017; Google 2019)
Kinosternon acutum	Cryptodira	Kinosternidae	Near Threatened	Unspecified	124678.1816	17.690669			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Kinosternon alamosae	Cryptodira	Kinosternidae	Data Deficient	Unknown	31731.68074	27.307838	4	105	(Iverson 1992b; Iverson *et al.* 1993; Hecnar 1999b; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Kinosternon angustipons	Cryptodira	Kinosternidae	Vulnerable	Unspecified	12237.61851	10.073042	1.5	112	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Kinosternon arizonense	Cryptodira	Kinosternidae	Least Concern	Stable	47713.99789	30.503674	4.7		(Iverson 1989; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Kinosternon baurii	Cryptodira	Kinosternidae	Least Concern	Unknown	341350.5769	31.002572	2.55	91.6	(Iverson et al. 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Kinosternon chimalhuaca	Cryptodira	Kinosternidae	Least Concern	Unknown	16292.82456	19.46086			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Kinosternon creaseri	Cryptodira	Kinosternidae	Least Concern	Stable	88334.88209	19.938	1	116	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Kinosternon dunni	Cryptodira	Kinosternidae	Vulnerable	Unspecified	9047.765427	6.278786	2	150	(Iverson 1992b; Iverson *et al.* 1993; Hecnar 1999b; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Kinosternon durangoense	Cryptodira	Kinosternidae	Data Deficient	Unknown	27278.18981	26.097544			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Kinosternon flavescens	Cryptodira	Kinosternidae	Least Concern	Unknown	1382481.008	33.512755	5.3533	114.43	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Kinosternon herrerai	Cryptodira	Kinosternidae	Near Threatened	Decreasing	86478.19358	21.181463	2	143.1	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Kinosternon hirtipes	Cryptodira	Kinosternidae	Least Concern	Decreasing	207499.5186	24.94192	3	107.4	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Kinosternon integrum	Cryptodira	Kinosternidae	Least Concern	Stable	458802.8519	22.679446	5	149.3	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Kinosternon leucostomum	Cryptodira	Kinosternidae	Not Listed	N/A	791169.3987	9.069126	1	137	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019)
Kinosternon oaxacae	Cryptodira	Kinosternidae	Data Deficient	Unknown	22672.62785	16.426269			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Kinosternon scorpioides	Cryptodira	Kinosternidae	Not Listed	N/A	6781733.539	-1.627003	3	115	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019)
Kinosternon sonoriense	Cryptodira	Kinosternidae	Near Threatened	Unknown	184756.5976	31.308447	4.3133	124.67	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Kinosternon steindachneri	Cryptodira	Kinosternidae	Least Concern	Unknown	89807.76192	27.905451		87.5	(Powell *et al.* 2016; Rhodin *et al.* 2017; Google 2019)
Kinosternon subrubrum	Cryptodira	Kinosternidae	Least Concern	Unknown	1543698.384	34.981114	3.25	93.85	(Iverson 1992b; Iverson *et al.* 1993; Hecnar 1999b; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Lepidochelys kempii	Cryptodira	Cheloniidae	Critically Endangered	Unknown	1596717.949	30.669352	106.09	657	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Lepidochelys olivacea	Cryptodira	Cheloniidae	Vulnerable	Decreasing	97296825.04	2.732609	108.93	633	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Leucocephalon yuwonoi	Cryptodira	Geoemydidae	Critically Endangered	Unspecified	31386.34656	0.219	1		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Lissemys ceylonensis	Cryptodira	Trionychidae	Not Listed	N/A	60970.68028	7.880438			(Rhodin *et al.* 2017; Google 2019)
Lissemys punctata	Cryptodira	Trionychidae	Least Concern	Unspecified	3211517.642	21.851272	8.855	205	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Lissemys scutata	Cryptodira	Trionychidae	Data Deficient	Unspecified	75742.02174	20.503622	11.88		(Iverson 1992b; Hecnar 1999b; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Macrochelys suwanniensis	Cryptodira	Chelydridae	Not Listed	N/A	16151.35741	30.070884	36	444	(Enge *et al.* 2014; Powell *et al.* 2016; Rhodin *et al.* 2017; Google 2019)
Macrochelys temminckii	Cryptodira	Chelydridae	Vulnerable	Unspecified	588338.1921	34.964587	25.52	400	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Malaclemys terrapin	Cryptodira	Emydidae	Vulnerable	Decreasing	151434.0443	33.527398	8.52	195	(Iverson *et al.* 1993; Powell *et al.* 2016; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Malacochersus tornieri	Cryptodira	Testudinidae	Critically Endangered	Decreasing	142927.3352	-3.619516	1.915	145	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Malayemys khoratensis	Cryptodira	Geoemydidae	Not Listed	N/A	34877.39687	16.414313			(Rhodin *et al.* 2017; Google 2019)

Table 6 (continued). Attribute data for 357 species of turtles (Note: PT = Population Trend, Range = Geographical Range Size (km^2), Midpoint = Midpoint Latitude (◦), CS = Mean Clutch Size, CL = Mean Female Carapace Length (mm)).

Scientific Name	Suborder	Family	Global IUCN Status	PT	Range	Midpoint	CS	CL	Sources
Malayemys macrocephala	Cryptodira	Geoemydidae	Not Listed	N/A	170446.2498	12.272206			(Rhodin *et al.* 2017; Google 2019)
Malayemys subtrijuga	Cryptodira	Geoemydidae	Vulnerable	Unspecified	189767.8487	12.923553			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Manouria emys	Cryptodira	Testudinidae	Critically Endangered	Decreasing	925871.4824	10.480069	32.76		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Manouria impressa	Cryptodira	Testudinidae	Vulnerable	Unspecified	601187.6141	15.693891	13		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Mauremys annamensis	Cryptodira	Geoemydidae	Critically Endangered	Unspecified	13826.30422	14.566932			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Mauremys caspica	Cryptodira	Geoemydidae	Not Listed	N/A	870978.0382	35.114822	5		(Ernst and Barbour 1989; Rhodin *et al.* 2017; Google 2019)
Mauremys japonica	Cryptodira	Geoemydidae	Near Threatened	Unspecified	162089.717	34.424437	6.165	150	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Mauremys leprosa	Cryptodira	Geoemydidae	Not Listed	N/A	949636.7553	36.025814	5.8	168.8	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019)
Mauremys mutica	Cryptodira	Geoemydidae	Endangered	Unspecified	990483.6563	24.171152	1.5	130	(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Mauremys nigricans	Cryptodira	Geoemydidae	Endangered	Unspecified	205738.2995	23.870105	3.5		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Mauremys reevesii	Cryptodira	Geoemydidae	Endangered	Unknown	1119558.423	30.405418	5.02	174.5	(Iverson *et al.* 1993; Zug 2013; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Mauremys rivulata	Cryptodira	Geoemydidae	Not Listed	N/A	388098.6523	38.32816	8		(Speybroeck *et al.* 2016; Rhodin *et al.* 2017; Google 2019)
Mauremys sinensis	Cryptodira	Geoemydidae	Endangered	Unspecified	494385.5967	23.276006	5.25	214	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Melanochelys tricarinata	Cryptodira	Geoemydidae	Vulnerable	Unspecified	315712.9037	25.883284	2	138	(Kumar *et al.* 2009; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Melanochelys trijuga	Cryptodira	Geoemydidae	Near Threatened	Unspecified	1611867.25	18.523231	3.835	175	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Mesoclemmys dahli	Pleurodira	Chelidae	Critically Endangered	Unspecified	29150.77622	9.480531	4	191	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Mesoclemmys gibba	Pleurodira	Chelidae	Not Listed	N/A	2920384.434	-1.105113	3	184.5	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019)
Mesoclemmys heliostemma	Pleurodira	Chelidae	Not Listed	N/A	1240495.102	-4.352941			(Rhodin *et al.* 2017; Google 2019)
Mesoclemmys hogei	Pleurodira	Chelidae	Critically Endangered	Decreasing	12825.32925	-21.709454	8		(Iverson 1992b; Hecnar 1999b; Rhodin *et al.* 2017; Google 2019; IUCN 2019f; IUCN 2020i)
Mesoclemmys nasuta	Pleurodira	Chelidae	Not Listed	N/A	184666.5216	4.04227	7		(Vogt 2008; Rhodin *et al.* 2017; Google 2019)
Mesoclemmys perplexa	Pleurodira	Chelidae	Not Listed	N/A	253274.8397	-8.915007			(Rhodin *et al.* 2017; Google 2019)
Mesoclemmys raniceps	Pleurodira	Chelidae	Not Listed	N/A	2271303.401	-7.566802	5.6		(Rhodin *et al.* 2017; Cunha *et al.* 2019; Google 2019)
Mesoclemmys tuberculata	Pleurodira	Chelidae	Not Listed	N/A	520162.5844	-10.096053			(Santana *et al.* 2016; Rhodin *et al.* 2017; Google 2019)
Mesoclemmys vanderhaegei	Pleurodira	Chelidae	Near Threatened	Unspecified	955253.5688	-18.331146	6.4		(Iverson 1992b; Hecnar 1999b; Marques *et al.* 2014; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Mesoclemmys zuliae	Pleurodira	Chelidae	Vulnerable	Unspecified	1498.110276	8.784567	7	263	(Iverson 1992b; Iverson *et al.* 1993; Hecnar 1999b; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Morenia ocellata	Cryptodira	Geoemydidae	Vulnerable	Unspecified	259329.0745	18.60912			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Morenia petersi	Cryptodira	Geoemydidae	Vulnerable	Unspecified	471004.9386	25.878341	8		(Aryal *et al.* 2010; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Myuchelys latisternum	Pleurodira	Chelidae	Not Listed	N/A	462876.6009	-20.272396	17	232	(Legler and Cann 1980; Rhodin *et al.* 2017; Google 2019)
Natator depressus	Cryptodira	Cheloniidae	Data Deficient	Unspecified	2354838.211	-16.502395	51.045	923	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Nilssonia formosa	Cryptodira	Trionychidae	Endangered	Unspecified	125568.478	21.043185	26.3333		(Rhodin *et al.* 2017; Platt *et al.* 2018; Google 2019; IUCN 2019f)
Nilssonia gangetica	Cryptodira	Trionychidae	Vulnerable	Unspecified	1350885.502	27.182781	30.135	675	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Nilssonia hurum	Cryptodira	Trionychidae	Vulnerable	Unspecified	845388.9172	25.991177	22.6667		(Das *et al.* 2010; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Nilssonia leithii	Cryptodira	Trionychidae	Vulnerable	Unknown	570791.8731	15.938402			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Nilssonia nigricans	Cryptodira	Trionychidae	Extinct in the Wild	Unspecified	96583.77974	25.165232	20.2	436	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Notochelys platynota	Cryptodira	Geoemydidae	Vulnerable	Unspecified	804325.4274	2.272848			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Orlitia borneensis	Cryptodira	Geoemydidae	Endangered	Unspecified	626133.3885	0.350834	12	475	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Palea steindachneri	Cryptodira	Trionychidae	Endangered	Unspecified	257916.567	20.263077	15.5		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Pangshura smithii	Cryptodira	Geoemydidae	Near Threatened	Unspecified	708343.6271	28.463224	6.635	190	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Pangshura sylhetensis	Cryptodira	Geoemydidae	Endangered	Unspecified	154805.7366	24.840922	9		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Pangshura tecta	Cryptodira	Geoemydidae	Least Concern	Unspecified	963573.3823	26.602614	7.5		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Pangshura tentoria	Cryptodira	Geoemydidae	Least Concern	Unspecified	469840.4959	23.472658	6.36	212.5	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Pelochelys bibroni	Cryptodira	Trionychidae	Vulnerable	Unspecified	268069.3786	-6.787621	26		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Pelochelys cantorii	Cryptodira	Trionychidae	Endangered	Unspecified	1653989.372	10.649015			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Pelochelys signifera	Cryptodira	Trionychidae	Vulnerable	Decreasing	109957.5213	-3.669564			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Pelodiscus axenaria	Cryptodira	Trionychidae	Not Listed	N/A	90290.66909	27.574465			(Rhodin *et al.* 2017; Google 2019)
Pelodiscus maackii	Cryptodira	Trionychidae	Not Listed	N/A	657694.9906	43.763193			(Rhodin *et al.* 2017; Google 2019)
Pelodiscus parviformis	Cryptodira	Trionychidae	Not Listed	N/A	114825.3709	19.649973			(Rhodin *et al.* 2017; Google 2019)
Pelodiscus sinensis	Cryptodira	Trionychidae	Vulnerable	Decreasing	1786617.216	30.224365	14.5	230	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Pelomedusa barbata	Pleurodira	Pelomedusidae	Not Listed	N/A	79978.18893	15.611715			(Rhodin *et al.* 2017; Google 2019)
Pelomedusa galeata	Pleurodira	Pelomedusidae	Least Concern	Unknown	722364.7032	-30.075026			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Pelomedusa gehafie	Pleurodira	Pelomedusidae	Not Listed	N/A	157663.3343	16.232838			(Rhodin *et al.* 2017; Google 2019)

Table 6 (continued). Attribute data for 357 species of turtles (Note: PT = Population Trend, Range = Geographical Range Size (km^2), Midpoint = Midpoint Latitude (◦), CS = Mean Clutch Size, CL = Mean Female Carapace Length (mm)).

Scientific Name	Suborder	Family	Global IUCN Status	PT	Range	Midpoint	CS	CL	Sources
Pelomedusa kobe	Pleurodira	Pelomedusidae	Not Listed	N/A	296814.8738	-5.807681			(Rhodin *et al.* 2017; Google 2019)
Pelomedusa neumanni	Pleurodira	Pelomedusidae	Not Listed	N/A	460363.7126	0.679782			(Rhodin *et al.* 2017; Google 2019)
Pelomedusa olivacea	Pleurodira	Pelomedusidae	Not Listed	N/A	1683940.853	13.025863			(Rhodin *et al.* 2017; Google 2019)
Pelomedusa schweinfurthi	Pleurodira	Pelomedusidae	Not Listed	N/A	418966.2811	6.091247			(Rhodin *et al.* 2017; Google 2019)
Pelomedusa somalica	Pleurodira	Pelomedusidae	Not Listed	N/A	306884.3672	9.429055			(Rhodin *et al.* 2017; Google 2019)
Pelomedusa subrufa	Pleurodira	Pelomedusidae	Not Listed	N/A	2154348.29	-14.224446	25.5	270	(Ernst and Barbour 1989; Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019)
Pelomedusa variabilis	Pleurodira	Pelomedusidae	Not Listed	N/A	389636.3736	10.614321			(Rhodin *et al.* 2017; Google 2019)
Peltocephalus dumerilianus	Pleurodira	Podocnemididae	Vulnerable	Unspecified	1845748.45	1.808225	11.8	324	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Pelusios adansonii	Pleurodira	Pelomedusidae	Not Listed	N/A	2079142.748	10.881575	7		(Ernst and barbour 1989; Rhodin *et al.* 2017; Google 2019)
Pelusios bechuanicus	Pleurodira	Pelomedusidae	Not Listed	N/A	355037.7173	-15.997654	32.25		(Broadley 1981; Iverson 1992b; Hecnar 1999b; Rhodin *et al.* 2017; Google 2019)
Pelusios broadleyi	Pleurodira	Pelomedusidae	Vulnerable	Unspecified	23679.31035	3.464762			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Pelusios carinatus	Pleurodira	Pelomedusidae	Not Listed	N/A	388473.5032	-1.531417			(Iverson 1992b; Hecnar 1999b; Rhodin *et al.* 2017; Google 2019)
Pelusios castaneus	Pleurodira	Pelomedusidae	Not Listed	N/A	1748253.312	1.762215	9		(Ernst and Barbour 1989; Bour *et al.* 2016; Rhodin *et al.* 2017; Google 2019)
Pelusios castanoides	Pleurodira	Pelomedusidae	Least Concern	Unspecified	1547270.235	-15.667035	25	220	(Ernst and Barbour 1989; Iverson 1992b; Iverson *et al.* 1993; Hecnar 1999b; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Pelusios chapini	Pleurodira	Pelomedusidae	Not Listed	N/A	1028560.788	1.124205			(Rhodin *et al.* 2017; Google 2019)
Pelusios cupulatta	Pleurodira	Pelomedusidae	Not Listed	N/A	344097.8921	6.302687			(Rhodin *et al.* 2017; Google 2019)
Pelusios gabonensis	Pleurodira	Pelomedusidae	Not Listed	N/A	2981682.854	-0.768546	12		(Iverson 1992b; Hecnar 1999b; Rhodin *et al.* 2017; Spawls *et al.* 2018; Google 2019)
Pelusios marani	Pleurodira	Pelomedusidae	Not Listed	N/A	50325.92485	-1.901661			(Rhodin *et al.* 2017; Google 2019)
Pelusios nanus	Pleurodira	Pelomedusidae	Not Listed	N/A	1047338.516	-10.457611			(Rhodin *et al.* 2017; Google 2019)
Pelusios niger	Pleurodira	Pelomedusidae	Near Threatened	Decreasing	278178.2951	2.177852	25	257.7	(Akani *et al.* 2015; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Pelusios rhodesianus	Pleurodira	Pelomedusidae	Least Concern	Unspecified	3066734.129	-14.251753	12.625	230	(Broadley 1981; Iverson 1992b; Iverson *et al.* 1993; Hecnar 1999b; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Pelusios seychellensis	Pleurodira	Pelomedusidae	Extinct	Unspecified	155.64	-4.648031			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Pelusios sinuatus	Pleurodira	Pelomedusidae	Not Listed	N/A	3284755.202	-12.445972	10		(Iverson 1992b; Hecnar 1999b; Branch 2016; Rhodin *et al.* 2017; Google 2019)
Pelusios subniger	Pleurodira	Pelomedusidae	Least Concern	Unspecified	2286246.326	-15.18629	8.5		(Broadley 1981; Iverson 1992b; Hecnar 1999b; Rhodin *et al.* 2017; Gerlach 2018; Google 2019; IUCN 2019f)
Pelusios upembae	Pleurodira	Pelomedusidae	Data Deficient	Unspecified	10709.16556	-8.702999			(Iverson 1992b; Hecnar 1999b; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Pelusios williamsi	Pleurodira	Pelomedusidae	Not Listed	N/A	179493.9328	-0.137333			(Iverson 1992b; Hecnar 1999b; Rhodin *et al.* 2017; Google 2019)
Phrynops geoffroanus	Pleurodira	Chelidae	Not Listed	N/A	3742007.503	-11.773345	15		(Ernst and Barbour 1989; Rhodin *et al.* 2017; Google 2019)
Phrynops hilarii	Pleurodira	Chelidae	Not Listed	N/A	797730.5523	-28.890451	18	280	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019)
Phrynops tuberosus	Pleurodira	Chelidae	Not Listed	N/A	215256.1048	5.170188			(Rhodin *et al.* 2017; Google 2019)
Phrynops williamsi	Pleurodira	Chelidae	Vulnerable	Decreasing	328922.4904	-28.967375	9		(Ernst and Barbour 1989; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Platemys platycephala	Pleurodira	Chelidae	Not Listed	N/A	5074985.226	-3.126892	1	150	(Ernst and Barbour 1989; Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019)
Platysternon megacephalum	Cryptodira	Platysternidae	Endangered	Unspecified	1120778.994	21.501034	2.25		(Jenkins 1995; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Podocnemis erythrocephala	Pleurodira	Podocnemididae	Vulnerable	Unspecified	799031.5258	-0.503688	8.43		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Podocnemis expansa	Pleurodira	Podocnemididae	Not Defined	Unspecified	2065033.881	-3.236399	97.115	660	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Podocnemis lewyana	Pleurodira	Podocnemididae	Critically Endangered	Decreasing	74213.19968	6.182906	18.5	475	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Podocnemis sextuberculata	Pleurodira	Podocnemididae	Vulnerable	Unspecified	792136.4667	-3.109082	51.5		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Podocnemis unifilis	Pleurodira	Podocnemididae	Vulnerable	Unspecified	2907785.183	-3.075128	26.815	360.2	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Podocnemis vogli	Pleurodira	Podocnemididae	Not Listed	N/A	240468.3595	5.455609	13.165	271	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019)
Psammobates geometricus	Cryptodira	Testudinidae	Critically Endangered	Decreasing	13067.49954	-33.312041	3.19	124.1	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Psammobates oculifer	Cryptodira	Testudinidae	Not Listed	N/A	1077342.903	-23.900913	1.5		(Branch 2016; Rhodin *et al.* 2017; Google 2019)
Psammobates tentorius	Cryptodira	Testudinidae	Near Threatened	Decreasing	694526.5958	-29.191217	2.115	125	(Iverson 1992b; Iverson *et al.* 1993; Hecnar 1999b; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Pseudemydura umbrina	Pleurodira	Chelidae	Critically Endangered	Unspecified	95.49337049	-31.742085	4.335	125	(Iverson 1992b; Iverson *et al.* 1993; Hecnar 1999b; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Pseudemys alabamensis	Cryptodira	Emydidae	Endangered	Unspecified	6130.122821	30.734503	13	254.5	(Nelson *et al.* 2009; Powell *et al.* 2016; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Pseudemys concinna	Cryptodira	Emydidae	Least Concern	Unknown	1240884.796	33.548019	17	289	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Pseudemys floridana	Cryptodira	Emydidae	Least Concern	Unknown	284711.8497	33.0982	14.15	280	(Iverson *et al.* 1993; Powell *et al.* 2016; Rhodin et al. 2017; Google 2019)
Pseudemys gorzugi	Cryptodira	Emydidae	Near Threatened	Unknown	71115.25499	29.656776	9	254.5	(Powell *et al.* 2016; Rhodin *et al.* 2017; Google 2019; IUCN 2019f; IUCN 2020j)
Pseudemys nelsoni	Cryptodira	Emydidae	Least Concern	Stable	113134.7207	28.204304	14.3	298	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Pseudemys peninsularis	Cryptodira	Emydidae	Least Concern	Unknown	85391.23156	27.855189	15	280	(Powell *et al.* 2016; Rhodin *et al.* 2017; Google 2019; IUCN 2019f; IUCN 2020k)
Pseudemys rubriventris	Cryptodira	Emydidae	Near Threatened	Unknown	86121.82427	37.902241	17	304	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Pseudemys texana	Cryptodira	Emydidae	Least Concern	Unknown	161765.7189	31.044119	8.4	217.5	(Lindeman 2007; Powell *et al.* 2016; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Pyxis arachnoides	Cryptodira	Testudinidae	Critically Endangered	Decreasing	20402.98271	-23.50958	1		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)

Table 6 (continued). Attribute data for 357 species of turtles (Note: PT = Population Trend, Range = Geographical Range Size (km^2), Midpoint = Midpoint Latitude (◦), CS = Mean Clutch Size, CL = Mean Female Carapace Length (mm)).

Scientific Name	Suborder	Family	Global IUCN Status	PT	Range	Midpoint	CS	CL	Sources
Pyxis planicauda	Cryptodira	Testudinidae	Critically Endangered	Decreasing	4685.723564	-19.86912	1.17		(Iverson 1992b; Hecnar 1999b; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Rafetus euphraticus	Cryptodira	Trionychidae	Endangered	Decreasing	351708.871	34.200547			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Rafetus swinhoei	Cryptodira	Trionychidae	Critically Endangered	Unspecified	82393.39106	26.484672			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Rheodytes leukops	Pleurodira	Chelidae	Vulnerable	Unspecified	8690.103673	-23.961051	18.8	249	(Iverson 1992b; Iverson *et al.* 1993; Hecnar 1999b; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Rhinemys rufipes	Pleurodira	Chelidae	Near Threatened	Unspecified	480481.3961	-0.173123	7.5		(Ernst and Barbour 1989; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Rhinoclemmys annulata	Cryptodira	Geoemydidae	Near Threatened	Unspecified	328269.268	6.920305	1.5		(Rhodin *et al.* 2017; Google 2019; IUCN 2019f; Leenders 2019)
Rhinoclemmys areolata	Cryptodira	Geoemydidae	Near Threatened	Decreasing	214663.5814	18.328362	1	166.6	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Rhinoclemmys diademata	Cryptodira	Geoemydidae	Not Listed	N/A	43947.65369	9.571282	2	203	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019)
Rhinoclemmys funerea	Cryptodira	Geoemydidae	Near Threatened	Unspecified	76431.0208	11.897212	3.2	273	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Rhinoclemmys melanosterna	Cryptodira	Geoemydidae	Not Listed	N/A	211474.3223	6.049135	5	243	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019)
Rhinoclemmys nasuta	Cryptodira	Geoemydidae	Near Threatened	Unspecified	90584.23622	3.443446	1	218	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Rhinoclemmys pulcherrima	Cryptodira	Geoemydidae	Not Listed	N/A	181670.4314	18.604778	1.5		(Rhodin *et al.* 2017; Google 2019; Leenders 2019)
Rhinoclemmys punctularia	Cryptodira	Geoemydidae	Not Listed	N/A	1639313.468	-1.49323	1.5		(Ernst and Barbour 1989; Rhodin *et al.* 2017; Google 2019)
Rhinoclemmys rubida	Cryptodira	Geoemydidae	Near Threatened	Decreasing	54458.90825	17.986547			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Sacalia bealei	Cryptodira	Geoemydidae	Endangered	Unspecified	199968.1772	24.65135	3.5		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Sacalia quadriocellata	Cryptodira	Geoemydidae	Endangered	Unspecified	348409.8176	19.481445	2		(Jenkins 1995; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Siebenrockiella crassicollis	Cryptodira	Geoemydidae	Vulnerable	Unspecified	928349.8018	4.07725	1.365	186	(Iverson 1992b; Iverson *et al.* 1993; Hecnar 1999b; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Siebenrockiella leytensis	Cryptodira	Geoemydidae	Critically Endangered	Unspecified	4924.42	10.561359	1.5		(Diesmos *et al.* 2012; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Staurotypus salvinii	Cryptodira	Staurotypidae	Near Threatened	Unspecified	40761.9242	15.002467	5.36	180	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Staurotypus triporcatus	Cryptodira	Staurotypidae	Near Threatened	Unspecified	182065.7947	17.877418	10.61	285	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Sternotherus carinatus	Cryptodira	Kinosternidae	Least Concern	Unknown	352096.744	32.741645	4.2	116.5	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Sternotherus depressus	Cryptodira	Kinosternidae	Critically Endangered	Decreasing	10093.10909	33.725957	2.2	95	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Sternotherus minor	Cryptodira	Kinosternidae	Least Concern	Unknown	370377.1442	32.806647	2.73	102.55	(Iverson 1992b; Iverson *et al.* 1993; Hecnar 1999b; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Sternotherus odoratus	Cryptodira	Kinosternidae	Least Concern	Stable	2135642.3	36.106362	3.775	97.2	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Stigmochelys pardalis	Cryptodira	Testudinidae	Least Concern	Unknown	7569425.193	-11.861399	10.9	484	(Iverson 1992b; Iverson *et al.* 1993; Hecnar 1999b; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Terrapene carolina	Cryptodira	Emydidae	Vulnerable	Decreasing	2663071.095	31.92525	3.855	134	(Iverson 1992b; Iverson *et al.* 1993; Hecnar 1999b; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Terrapene coahuila	Cryptodira	Emydidae	Endangered	Decreasing	2228.232533	26.92915	3.255	101.6	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Terrapene nelsoni	Cryptodira	Emydidae	Data Deficient	Unspecified	54118.62002	25.276717	2.69	134	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Terrapene ornata	Cryptodira	Emydidae	Near Threatened	Decreasing	1694862.879	35.716161	4.39	117	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Testudo graeca	Cryptodira	Testudinidae	Vulnerable	Unspecified	1833795.542	36.745387	4.955	189	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Testudo hermanni	Cryptodira	Testudinidae	Near Threatened	Decreasing	352313.6986	41.603166	4.8075	190	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Testudo horsfieldii	Cryptodira	Testudinidae	Vulnerable	Unspecified	1395626.829	39.304597	4		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Testudo kleinmanni	Cryptodira	Testudinidae	Critically Endangered	Decreasing	90369.62785	31.513048	2.93		(Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Testudo marginata	Cryptodira	Testudinidae	Least Concern	Stable	65530.06297	38.98508	6.07	253	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Trachemys adiutrix	Cryptodira	Emydidae	Endangered	Unspecified	31137.11821	-2.689964			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Trachemys callirostris	Cryptodira	Emydidae	Not Listed	N/A	135258.8427	9.026841	11	260	(Ernst 2003a; Bock *et al.* 2010; Rhodin et al. 2017; Google 2019)
Trachemys decorata	Cryptodira	Emydidae	Vulnerable	Unspecified	11215.99915	18.446403	12	261	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Trachemys decussata	Cryptodira	Emydidae	Not Listed	N/A	124117.7561	20.731081	5	171	(Iverson *et al.* 1993; Rhodin *et al.* 2017; Google 2019)
Trachemys dorbigni	Cryptodira	Emydidae	Not Listed	N/A	456245.9743	-31.526073	13.05	260	(Iverson *et al.* 1993; Bager *et al.* 2007; Rhodin *et al.* 2017; Google 2019)
Trachemys gaigeae	Cryptodira	Emydidae	Vulnerable	Unknown	69481.63036	29.770134	19	164	(Morjan and Stuart 2001; Powell *et al.* 2016; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Trachemys grayi	Cryptodira	Emydidae	Not Listed	N/A	228065.2056	12.131748			(Rhodin *et al.* 2017; Google 2019)
Trachemys nebulosa	Cryptodira	Emydidae	Not Listed	N/A	32955.39204	25.272894			(Rhodin *et al.* 2017; Google 2019)
Trachemys ornata	Cryptodira	Emydidae	Vulnerable	Decreasing	36236.74741	22.769475	20		(Rhodin *et al.* 2017; Google 2019; IUCN 2019f; IUCN 2020l)
Trachemys scripta	Cryptodira	Emydidae	Least Concern	Stable	1808510.103	34.717577	9.007	164	(Iverson *et al.* 1993; Powell *et al.* 2016; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Trachemys stejnegeri	Cryptodira	Emydidae	Near Threatened	Unspecified	53578.9163	19.589167	8.5		(Rhodin *et al.* 2017; USGS 2018; Google 2019; IUCN 2019f)
Trachemys taylori	Cryptodira	Emydidae	Endangered	Decreasing	2820.901206	27.174885			(Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Trachemys terrapen	Cryptodira	Emydidae	Vulnerable	Unspecified	10469.16815	18.04401	5.5		(Currie *et al.* 2019; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Trachemys venusta	Cryptodira	Emydidae	Not Listed	N/A	604963.6894	16.507278	26.5	300	(Ernst and Seidel 2006; Rhodin *et al.* 2017; Google 2019; Leenders 2019)
Trachemys yaquia	Cryptodira	Emydidae	Vulnerable	Decreasing	56996.33319	28.902469		275	(Ernst 2003b; Rhodin *et al.* 2017; Google 2019; IUCN 2019f)
Trionyx triunguis	Cryptodira	Trionychidae	Vulnerable	Decreasing	7367511.81	4.26208	47.5	506	(Iverson 1992b; Iverson *et al.* 1993; Hecnar 1999b; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)
Vijayachelys silvatica	Cryptodira	Geoemydidae	Endangered	Unknown	26944.72106	11.325848	2	121	(Iverson *et al.* 1993; Rhodin *et al.* 2017; CITES 2018; Google 2019; IUCN 2019f)