

Reprint From:

(Chelonian Research Monographs: ISSN 1088-7105)

BIOLOGY AND CONSERVATION OF FLORIDA TURTLES

EDITED BY
PETER A. MEYLAN

Foreword

**Turtles and Humans in Florida and the World:
a Global Perspective on Diversity, Threats, and Economic Development**

ANDERS G.J. RHODIN

CHELONIAN RESEARCH MONOGRAPHS

Number 3 – November 2006

**Published by
Chelonian Research Foundation**

in association with

**Coastal Wildlife Club, Gopher Tortoise Council, Florida Turtle Conservation Trust,
Eckerd College, and IUCN/SSC Tortoise and Freshwater Turtle Specialist Group**





Gulf coast shore of Egmont Key, Tampa Bay, Florida, with two sets of gopher tortoise (*Gopherus polyphemus*) tracks and a set of human footprints. The future paths and survival prospects for turtles and tortoises are inextricably intertwined with and dependent on habitat and wildlife conservation efforts by humans. Photo by Anders Rhodin.

Foreword

Turtles and Humans in Florida and the World: a Global Perspective on Diversity, Threats, and Economic Development

ANDERS G.J. RHODIN^{1,2}

¹*Chelonian Research Foundation, 168 Goodrich Street, Lunenburg, Massachusetts 01462 [RhodinCRF@aol.com]*

²*Chair, IUCN/SSC Tortoise and Freshwater Turtle Specialist Group*

As I prepared this book for publication, and read and reviewed all the contributions, it became increasingly clear that turtles in Florida face major threats and conservation challenges as a direct result of the rapid development, urbanization, and habitat loss occurring in the State. Some might even say that turtles are being bulldozed into oblivion in Florida, and in many ways, this would not be far from the truth. I felt that this development problem was pervasive enough that I even suggested to Peter Meylan that he consider changing the title of this book to *Turtles of Florida: Biology and Conservation in a Developed Landscape*. Peter gently declined and correctly pointed out that Florida is in fact a complex mosaic of both developed and undeveloped areas, and he preferred his original title.

Fair enough, but it made me consider more closely the challenges that turtles face in Florida, and how those challenges are inter-related with humans and their complex developmental pressures. I thought about Florida in the context of the rest of the world, and how threatened Florida's turtles might be in comparison to other areas, notably Asia, where turtles have been in terrible trouble for decades (van Dijk et al., 2000) as a result of massive direct exploitation for food, medicine, and the pet trade, in addition to habitat loss. I wondered how Florida would compare to Asia and elsewhere in terms of the threat levels to its turtles and the conservation challenges posed by its levels of urbanization and development.

Clearly, turtles in Florida face major threats from rapid development caused by the incredibly rapid growth of its human population and the concomitant rapid expansion of its percent and extent of urbanization (Reynolds, 2001; Enge et al., 2006). Huge parts of Florida's native habitat are literally disappearing under the trappings of development: asphalt, concrete, and artificial landscapes. Urban sprawl, malls, housing developments, roads and highways, industrial parks, agricultural orchards and fields, silvicultural forests, hydrological engineering, and other anthropogenic habitat alterations are rapidly impacting and destroying the remnants of available turtle habitat. And with the increasing loss of these habitats, Florida also increasingly loses its turtles (Enge et al., 2006).

I decided to analyze how Florida would rank globally in terms of conservation prioritization for its turtles if one compared it to other areas of the world. Such an analysis was recently performed by Stuart and Thorbjarnarson (2003) for

several nations in Asia, using turtle diversity, endemism, and threat level per species as the basis for a ranking system for turtle conservation prioritization among nations. In addition, I wanted to try to correlate the threat levels faced by turtles all over the world with some measure of human economic development to attempt to better understand the complex interactions between turtles and humans.

Methods. — I analyzed diversity, endemism, and threat levels for turtles for all 155 global nations and territories that have native freshwater turtles or tortoises, with or without marine turtles, including the State of Florida as if it were a separate nation. Nations with only marine turtles were excluded from the analysis. Analysis of the USA as a whole nation included Florida, despite also treating Florida as a separate entity.

Analysis included all turtle taxa (freshwater turtles, tortoises, marine turtles; species and subspecies) most widely and currently recognized as distinct (updated from Iverson, 1992, 2006; Fritz and Havas, in review; TTWG, in review; as well as all recent turtle taxonomic literature). All data were compiled into an unpublished database (Rhodin, unpubl. data). I followed a liberal interpretation of what constitutes a distinct and recognized taxon of turtle, accepting most recent taxonomic revisions unless reasonably refuted by subsequent analysis (published or not).

Turtle diversity (= richness) was defined as the number of taxa (species and subspecies) of freshwater turtles, tortoises, and marine turtles occurring (living or extinct since 1500 AD) per nation. Marine turtles were excluded from the earlier analysis by Stuart and Thorbjarnarson (2003), but I included them in this analysis because of their importance in Florida, so that global comparisons reflected total turtle faunas, rather than just freshwater turtles and tortoises. Presence of marine turtles in nations was recorded as per their listing in the 2006 IUCN Red List, which is based on primarily nesting rather than just foraging presence.

Endemism was recorded per nation as (a) percent endemism, and (b) total number of endemic taxa. Taxon density was defined as number of taxa per 1000 sq.km. national area.

Threat levels used for all taxa in all nations (except Florida) were the most recent 2006 IUCN Red List global status determinations (EX = Extinct; EW = Extinct in the Wild; CR = Critically Endangered; EN = Endangered; VU = Vulnerable) (IUCN, 2006). A potential problem with this analysis is that not all IUCN Red List evaluations are up-to-

date, with many species not re-evaluated since 1996, especially the turtle taxa of North and South America, Africa, and Australia. The taxa that have had the most recent and thorough evaluations are the Asian species, which were all evaluated in late 1999 (TFTSG and ATTWG, 2000), making it likely that they have somewhat higher average status listings than species that have not been evaluated since 1996. For example, the species of African turtles and tortoises appear to be under significant threat from the bushmeat trade (Lawson, 2000; Luiselli et al., 2006), but only a few species have been re-evaluated recently, and average threat levels for African nations are most likely under-listed.

For Florida turtles, the current IUCN Red List evaluations are all from 1996 and not reflective of the rapid development and habitat loss that have occurred in the state over the last decade. Therefore, the threat levels for four Florida turtle taxa used in this analysis were adjusted higher to reflect recent regional evaluations and determinations, using Enge et al. (2006) plus all chapters in this volume, including Table 1 on p. 30 of the Introduction. These adjustments, as provisionally suggested below, were made in order to provide more accurate up-to-date threat levels for Florida turtles as the basis for this global comparison.

The gopher tortoise, *Gopherus polyphemus*, has been listed by IUCN as VU since 1982. However, a recent thorough evaluation of its status in Florida using IUCN-based criteria (IUCN, 2001) has led to its recent uplisting in the state to Threatened (Enge et al., 2006; Mushinsky et al., this volume). The primary basis for the uplisting was an inferred population size reduction state-wide of between 50 and 60% over the past three tortoise generations (60–93 yrs), based on an observed 50–60% decline in the area of occupancy through loss of available habitat (Enge et al., 2006). Those same criteria would qualify the species as EN by the IUCN Red List criteria (IUCN, 2001) (if similar reductions have occurred in other parts of its range, which they apparently have), and I have therefore adjusted the threat level for the species to EN for Florida for this analysis.

The two species of map turtles in Florida, *Graptemys barbouri* and *G. ernsti*, are both currently classified as Near Threatened (NT) by IUCN. All species of *Graptemys* were recently listed on CITES Appendix III by the USA. Both *G. barbouri* and *G. ernsti* are classified as Globally Imperiled by Florida Natural Areas Inventory (Ewert et al., this volume; Aresco and Shealy, this volume) and both probably warrant at least a VU classification by IUCN, and I therefore rank them that way for Florida for this analysis. The Suwannee cooter, *Pseudemys concinna suwanniensis*, is considered a Species of Special Concern by the State of Florida (Jackson, this volume) and also probably warrants a VU classification, which is how I rank it for Florida for this analysis.

The two other Florida non-marine turtles already listed as threatened by IUCN retain their current rankings without adjustment for this analysis: the alligator snapper, *Macrochelys temminckii* (VU), and the spotted turtle, *Clemmys guttata* (VU). Other Florida non-marine turtles are listed by IUCN as either NT or not listed (implying a Least

Concern status as of 1996), and at this time there do not appear to be compelling reasons to uplist them. In addition, all five species of marine turtles in Florida are listed globally by IUCN as either CR or EN.

Though four taxa of turtles were provisionally adjusted for threat level for Florida in this analysis, no such changes were made for analysis of the USA as a whole.

Threat level was recorded as (a) Total Threat Level [TTL] = (No. EX taxa x 3.0) + (No. EW taxa x 2.0) + (No. CR taxa x 2.0) + (No. EN taxa x 1.0) + (No. VU taxa x 0.5), and (b) Average Threat Level [ATL] = (TTL / number of taxa). These formulas used the methodology developed by Stuart and Thorbjarnarson (2003) with modifications for assessing EW and VU taxa (which they did not assess) and assigned similar modifier values. EW was valued at the same modifier level as CR (2.0) and VU was valued at a modifier of 0.5, half the value for EN. These modifiers are arbitrary, but generally reflective of the relative values of the different threat levels (see Stuart and Thorbjarnarson, 2003).

Prioritizations for turtle conservation action were analyzed through two separate methods. Method A was similar to that developed by Stuart and Thorbjarnarson (2003), ranking the sums of ranks of richness, percent endemism, and average threat level. It differed from their method by including subspecies in addition to species, and VU species in addition to the more threatened categories. Method B differed from that developed by Stuart and Thorbjarnarson (2003), ranking the sums of ranks of richness, total endemism, and total threat level, as well as including subspecies and VU taxa. In terms of prioritizing nations for turtle conservation action, either method may be applied, with method A focusing on areas of highest percent endemism and average threat levels, and method B focusing on areas of greatest total endemism and total threat levels.

Finding a relevant global measure of “development” in order to compare other nations with Florida was problematic. There is no available global index of development that quantifies extent of urbanization and loss of natural habitat due to physical development, as is occurring so rampantly in Florida. The United Nations provides global measures of human population percentages that inhabit urban areas (www.unfpa.org/swp/2006), but these numbers are not directly correlated with habitat loss or extent of urbanization. Measures of human population density are also available globally, but do not measure development.

Although in Florida we are concerned mainly with the threats from physical development with resultant habitat loss, one can also consider the meaning of “development” in human social and economic terms. In fact, the meaning of the designations “developed” and “developing” for the nations of the world is traditionally defined more by their development in human social and economic terms rather than what we typically call development in the physical sense, as is occurring in Florida, with urbanization and destruction of natural habitats.

A widely available index for the degree of human social and economic development is the Human Development Index

Table 1. Diversity (Richness). Top 20 ranking of 155 global nations and territories (including Florida) with the highest richness of taxa of turtles and tortoises (species and subspecies). Nation color indicates Human Development Index (HDI); green = developed, orange = developing, red = underdeveloped, black = no data (see text and Appendix). Nations in italics have lost all their non-marine turtle taxa to extinction (none in this table).

Nations and Territories		Taxa Present
1	United States of America	88
2	Mexico	63
3	Australia	42
4	Brazil	39
5	Florida, USA	38
5	India	38
7	Indonesia	36
8	Colombia	32
9	Myanmar	30
10	China (People's Republic of China)	29
10	Thailand	29
10	Vietnam	29
13	Ecuador	28
14	South Africa	26
15	Bangladesh	25
15	Venezuela	25
17	Malaysia	23
18	Congo (Democratic Republic of the Congo)	18
19	Guatemala	17
20	Laos	16

(HDI) provided by the United Nations (UNDP, 2005). This index ranks nations according to criteria of average achievements in several basic dimensions of human social and economic development, including: a long and healthy life, as measured by life expectancy at birth; knowledge, as measured by the adult literacy rate and the combined gross enrollment ratio for primary, secondary, and tertiary schools; and a decent standard of living, as measured by GDP per capita in purchasing power parity in US dollars. "High development" (= developed) areas have $HDI \geq 0.80$, "medium development" (= developing) areas have $HDI < 0.80$ and ≥ 0.50 , and "low development" (= underdeveloped) areas have $HDI < 0.50$. This index has come to be accepted as a means of comparing standard-of-living in the nations of the world (http://en.wikipedia.org/wiki/Human_Development_Index).

Table 2a. Percentage Endemism. Top 20 ranking of 155 global nations and territories (including Florida) with the highest percentage of endemic taxa of turtles and tortoises (species and subspecies). Color-coding of nations by HDI category and italicization as per Table 1.

Nations and Territories	Endemic Taxa		
	%	No.	
1	Australia	83.33%	35
2	<i>Mauritius (incl. Rodrigues)</i>	80.00%	4
3	Seychelles	77.78%	7
4	United States of America	67.05%	59
5	Madagascar	57.14%	8
6	Mexico	49.21%	31
7	Morocco	44.44%	4
7	Japan	44.44%	4
9	Ecuador	35.71%	10
10	Italy	33.33%	3
10	Réunion	33.33%	1
12	China (People's Republic of China)	31.03%	9
13	Brazil	28.21%	11
14	Florida, USA	23.68%	9
15	Myanmar	23.33%	7
16	South Africa	23.08%	6
17	Libya	20.00%	1
17	Puerto Rico	20.00%	1
19	Turkey	18.75%	3
20	India	18.42%	7

I chose to use HDI as an available means to compare Florida with the rest of the world in terms of how this aspect of human economic development might correlate with threat levels to turtles. As no separate HDI value has been calculated for Florida, the one for the USA was used instead (which may or may not be entirely accurate, depending on the average life expectancy, education level, and standard of living in Florida as compared to the rest of the USA).

The use of HDI as a measure of human economic development does not necessarily correlate with the degree of physical development and urbanization, but is more a measure of social progress and may correlate more with quality-of-life factors such as social responsibility, environmental ethics, and conservation awareness. As such, its use in this analysis should correlate more with a national ethic for prevention and lessening of threats to turtles than with the actual threats of direct exploitation or physical development leading to urbanization and habitat loss.

Results. — My analysis covered 475 taxa (species and subspecies) of turtles and tortoises. Since the analysis covered all turtle taxa extant since 1500 AD, it also included a few extinct taxa (11), most of which disappeared relatively long ago (e.g., Indian Ocean island tortoises of the genus *Cylindraspis*). All data in the analysis are summarized in the Appendix.

Diversity (or richness) of turtle taxa is ranked by nation in Table 1. The most turtle-rich nation in the world is the USA (88 taxa), with Mexico ranked No. 2 (63 taxa), Australia No. 3 (42 taxa), Brazil No. 4 (39 taxa), and Florida ranked No. 5 (38 taxa), tied with India. This emphasizes how important Florida's turtle fauna is on a global scale. In fact, fully 8.0% of the world's turtle diversity occurs in Florida, which represents just 0.1% of the area of all nations with turtles. The many turtle-rich nations of Asia are well represented on the top of this list also, including Indonesia (No. 7), Myanmar (No. 9), and China, Thailand, and Vietnam (tied at No. 10).

Percentage of endemism of turtle taxa is ranked by nation in Table 2a. The highest ranked nations on this list

Table 2b. Total Endemism. Top 20 ranking of 155 global nations and territories (including Florida) with the most endemic taxa of turtles and tortoises (species and subspecies). Color-coding of nations by HDI category and italicization as per Table 1.

Nations and Territories	Endemic Taxa	
1	United States of America	59
2	Australia	35
3	Mexico	31
4	Brazil	11
5	Ecuador	10
6	Florida, USA	9
6	China (People's Republic of China)	9
8	Madagascar	8
9	India	7
9	Myanmar	7
9	Seychelles	7
12	South Africa	6
13	Indonesia	5
13	Vietnam	5
15	Morocco	4
15	Japan	4
15	<i>Mauritius (incl. Rodrigues)</i>	4
18	Colombia	3
18	Venezuela	3
18	Turkey	3

Table 3a. Average Threat Level. Top 20 ranking of 155 global nations and territories (including Florida, ranked No. 90) with the highest average threat level per taxon of freshwater turtles and tortoises (species and subspecies, not including marine turtles). Color-coding of nations by HDI category and italicization as per Table 1.

Nations and Territories	Threat Level
1 <i>Mauritius (incl. Rodrigues)</i>	2.600
2 <i>Réunion</i>	2.000
3 <i>Seychelles</i>	1.944
4 <i>China (People's Republic of China)</i>	1.328
5 Puerto Rico	1.200
5 <i>Bahrain</i>	1.200
7 <i>Taiwan (Republic of China)</i>	1.167
8 <i>Jamaica</i>	1.125
9 <i>Bahamas</i>	1.083
9 <i>Haiti</i>	1.083
9 <i>Dominican Republic</i>	1.083
12 <i>Philippines</i>	1.056
13 <i>Vietnam</i>	1.052
14 <i>Cuba</i>	1.000
14 <i>Maldives</i>	1.000
14 <i>Yemen</i>	1.000
17 <i>Japan</i>	0.944
18 <i>Malaysia</i>	0.935
19 <i>Myanmar</i>	0.900
20 <i>Indonesia</i>	0.847
90 <i>Florida, USA</i>	0.303

are the island nations with most of their turtle taxa endemic. Australia tops the list at 83% of its 35 taxa; Mauritius (including Rodrigues) is at 80% but all 4 of its endemic taxa are already extinct (Gerlach, 2004); Seychelles is at 78%, but 3 of its endemic taxa are extinct (Gerlach, 1977). Both the USA and Madagascar also have high percentages of endemism. Florida ranks No. 14 on the list, fairly high, and most similar to Myanmar and South Africa.

Total endemism of turtle taxa is ranked by nation in Table 2b. Here, the USA tops the list with 59 endemic taxa,

Table 4a. Prioritization A. Ranking methodology similar to that developed by Stuart and Thorbjarnarson (2003). Top 25 ranking of 155 global nations and territories (including Florida) for conservation prioritization for taxa of turtles and tortoises (species and subspecies), as measured by the sum of ranks of rankings for Richness (Table 1), Percentage Endemism (Table 2a), and Average Threat Level (Table 3a). Color-coding of nations by HDI category and italicization as per Table 1.

Nations and Territories	Sum of Ranks
1 <i>China (People's Republic of China)</i>	27.0
2 <i>Myanmar</i>	43.0
3 <i>Vietnam</i>	46.0
4 <i>Ecuador</i>	47.0
5 <i>Indonesia</i>	56.0
6 <i>Seychelles</i>	63.0
7 <i>India</i>	65.5
8 <i>Madagascar</i>	68.0
9 <i>Japan</i>	81.5
10 <i>Bangladesh</i>	90.5
11 <i>Mexico</i>	93.0
12 <i>Taiwan (Republic of China)</i>	97.0
13 <i>Australia</i>	100.5
14 <i>Philippines</i>	102.0
15 <i>Papua New Guinea</i>	104.0
16 <i>Brazil</i>	106.0
17 <i>Mauritius (incl. Rodrigues)</i>	106.5
18 <i>United States of America</i>	109.0
19 <i>Florida, USA</i>	109.5
20 <i>Turkey</i>	110.5
21 <i>Colombia</i>	116.0
22 <i>Sri Lanka</i>	118.0
23 <i>Bahamas</i>	121.5
24 <i>Venezuela</i>	123.5
25 <i>Puerto Rico</i>	126.5

Table 3b. Total Threat Level. Top 20 ranking of 155 global nations and territories (including Florida) with the highest total threat level for its taxa of freshwater turtles and tortoises (species and subspecies, not including marine turtles). Color-coding of nations by HDI category and italicization as per Table 1.

Nations and Territories	Threat Level
1 <i>China (People's Republic of China)</i>	38.5
2 <i>Vietnam</i>	30.5
2 <i>Indonesia</i>	30.5
4 <i>Myanmar</i>	27.0
5 <i>Thailand</i>	24.0
6 <i>India</i>	23.0
7 <i>Ecuador</i>	22.5
8 <i>Mexico</i>	21.5
9 <i>Malaysia</i>	21.5
10 <i>United States of America</i>	18.0
11 <i>Seychelles</i>	17.5
11 <i>Bangladesh</i>	17.5
13 <i>Mauritius (incl. Rodrigues)</i>	13.0
13 <i>Colombia</i>	13.0
13 <i>Laos</i>	13.0
16 <i>Australia</i>	12.0
16 <i>Brazil</i>	12.0
18 <i>Florida, USA</i>	11.5
19 <i>Cambodia</i>	11.0
20 <i>Taiwan (Republic of China)</i>	10.5

far ahead of Australia (35) and Mexico (31). China and Florida are tied at No. 6, each with 9 endemic taxa, Florida's all being subspecies. Of the island nations with high percentages of endemism, only Australia, Madagascar, and Seychelles have high total endemism.

Average threat level of turtle taxa is ranked by nation in Table 3a. The two nations with all their non-marine turtles EX top the list, with Mauritius at 2.600 and Réunion at 2.000. Seychelles, with 3 taxa EX, ranks at No. 3 with a score of 1.944. China ranks at No. 4 with 1.328 points, topping all major nations with rich turtle faunas and the highest average

Table 4b. Prioritization B. Ranking methodology different from that developed by Stuart and Thorbjarnarson (2003). Top 25 ranking of 155 global nations and territories (including Florida) for conservation prioritization for taxa of turtles and tortoises (species and subspecies), as measured by the sum of ranks of rankings for Richness (Table 1), Total Endemism (Table 2b), and Total Threat Level (Table 3b). Color-coding of nations by HDI category and italicization as per Table 1.

Nations and Territories	Sum of Ranks
1 <i>Indonesia</i>	9.5
2 <i>Mexico</i>	10.5
3 <i>United States of America</i>	11.0
4 <i>India</i>	11.5
5 <i>China (People's Republic of China)</i>	12.0
6 <i>Myanmar</i>	13.0
7 <i>Vietnam</i>	13.5
8 <i>Thailand</i>	16.0
9 <i>Australia</i>	19.5
10 <i>Ecuador</i>	20.0
11 <i>Brazil</i>	20.5
12 <i>Colombia</i>	22.0
13 <i>Florida, USA</i>	23.5
14 <i>Malaysia</i>	25.5
15 <i>Bangladesh</i>	27.0
16 <i>Laos</i>	35.5
17 <i>Venezuela</i>	38.5
18 <i>Guatemala</i>	45.5
19 <i>Cambodia</i>	50.0
20 <i>Nicaragua</i>	51.5
21 <i>Madagascar</i>	52.0
21 <i>Honduras</i>	52.0
23 <i>Papua New Guinea</i>	54.0
24 <i>Panama</i>	55.5
25 <i>Turkey</i>	56.5

threat levels for Asia. Florida ranks No. 90 among 155 nations, indicating a relatively average threat level on a global comparative scale.

Total threat level of turtle taxa is ranked by nation in Table 3b. Here, China tops the list with 38.5 total points, followed closely by several Asian nations (Vietnam, Indonesia, Myanmar, Thailand, and India) at Nos. 2–6. Ecuador ranks No. 7 due to its many threatened and extinct subspecies of Galapagos tortoises, *Geochelone nigra* (Pritchard, 1996). Florida ranks No. 18 out of 155 nations on the list, indicating a high total threat level on a global comparative scale.

Prioritization of turtle conservation action by Method A is ranked by nation in Table 4a. Method A utilized a ranking methodology similar to that developed by Stuart and Thorbjarnarson (2003) and measured the sum of ranks of rankings for Richness (Table 1), Percentage Endemism (Table 2a), and Average Threat Level (Table 3a). The top nation here is China, as it was when analyzed by Stuart and Thorbjarnarson (2003), confirming their recommendation that China should be prioritized for turtle conservation efforts, at least when using these criteria. That the country still ranks No. 1 when compared globally as opposed to just within Asia is powerful testament to the need for turtle conservation efforts there. Many of the other developing nations of Asia rank right below China, with Myanmar, Vietnam, Indonesia, and India being highly prioritized. Ecuador comes in high due to its Galapagos tortoises, most of which are already receiving considerable conservation action and protection (Pritchard, 1996). Mexico, Madagascar, and Australia also rank high on this list, indicating need for focused turtle conservation action in those turtle-rich nations. Florida ranks No. 19, high on a global basis, also indicating the need for heightened conservation action for its turtle taxa.

Prioritization of turtle conservation action by Method B is ranked by nation in Table 4b. Method B utilized a ranking methodology different from that developed by Stuart and Thorbjarnarson (2003) and measured the sum of ranks of rankings for Richness (Table 1), Total Endemism (Table 2b), and Total Threat Level (Table 3b). As a result, the turtle-rich nations gravitate to the top of the list, with Indonesia, Mexico, and the USA ranked Nos. 1–3, respectively. India ranks No. 4, and China still manages to rank No. 5, followed closely by other major Asian nations (Myanmar, Vietnam, and Thailand). Florida now ranks No. 13 on the list, indicating its high importance in terms of considerations for conservation action based on its rich turtle fauna.

Density of turtle taxa is ranked by nation in Table 5. The first listing includes all nations of the world, including very small ones that have disproportionately high turtle densities by virtue of their very small size. Several small island nations (Seychelles, Singapore, Cayman Islands, and Maldives) top this list, despite those nations having relatively few turtle taxa. Florida ranks No. 24, indicating a relatively high density of turtle taxa, even when compared to some of these smaller nations. The second listing separates out the larger nations and territories with national areas > 100,000 sq. km. These are the nations with the highest densities of turtle taxa over relatively large areas. Coming in at the No. 1 ranking is Florida, further

Table 5. Taxon Density. Top 20 ranking of global nations and territories (including Florida) with the highest density of taxa of turtles and tortoises (species and subspecies). First listing for all 155 nations; second listing for the 99 largest nations with land areas > 100,000 sq. km. Color-coding of nations by HDI category and italicization as per Table 1.

	Nations and Territories	Density of Taxa per 1000 sq. km.
1	Seychelles	19.780
2	Singapore	11.713
3	Cayman Islands	11.538
4	Maldives	10.067
5	Bahrain	7.205
6	São Tomé and Príncipe	2.997
7	Mauritius (incl. Rodrigues)	2.451
8	Trinidad and Tobago	2.145
9	Brunei	1.214
10	Réunion	1.197
11	Gambia	0.655
12	Puerto Rico	0.549
13	Lebanon	0.481
14	Belize	0.479
15	Bahamas	0.430
16	Israel	0.392
17	Jamaica	0.364
18	Swaziland	0.346
19	Cyprus	0.324
20	El Salvador	0.285
<hr/>		
	Nations and Territories with Area > 100,000 sq. km.	
1	Florida, USA	0.223
2	Bangladesh	0.169
3	Guatemala	0.156
4	Honduras	0.133
5	Nicaragua	0.123
6	Ecuador	0.103
7	Nepal	0.088
7	Vietnam	0.088
9	Suriname	0.079
10	Cambodia	0.077
11	Eritrea	0.074
12	Malaysia	0.070
12	Benin	0.070
14	Laos	0.068
14	Malawi	0.068
16	Guyana	0.065
17	Thailand	0.057
18	Senegal	0.056
19	Cuba	0.054
20	Dominican Republic	0.048

testament to how special and important the turtle fauna of Florida is on a global scale.

Correlation between threat levels and human social and economic development (HDI group ranking) was then analyzed. The average threat level per turtle taxon is ranked by nation in Table 6 for the 51 global nations and territories (including Florida) with the richest turtle faunas (≥ 10 taxa). These turtle-rich nations were analyzed so as to minimize possible variation based on disproportionately high threat levels for nations with only a few turtle taxa. However, an analysis was also run for all nations with turtles.

Of note is that China heads this group of turtle-rich nations, having the highest average threat level (1.328), with the other developing nations of Asia ranked closely right behind (Vietnam, Malaysia, Myanmar, Indonesia, Thailand, and Laos, with Cambodia and Bangladesh right below). Only two non-Asian nations rank in the top 10 (Ecuador and Madagascar). Florida, with an average threat level of 0.303, ranks at No. 36 out of 51, indicating relatively lower average threats on its turtles when compared to other nations with turtle-rich faunas.

Table 6. Average Threat Level, Turtle-Rich Nations. Ranking of 51 global nations and territories (including Florida) with ≥ 10 taxa of turtles and tortoises (species and subspecies), ranked by average threat level per taxon. Color-coding of nations by HDI category and italicization as per Table 1.

Nations and Territories	Threat Level
1 China (People's Republic of China)	1.328
2 Vietnam	1.052
3 Malaysia	0.935
4 Myanmar	0.900
5 Indonesia	0.847
6 Thailand	0.828
7 Laos	0.813
8 Ecuador	0.804
9 Cambodia	0.786
10 Madagascar	0.714
11 Bangladesh	0.700
12 Papua New Guinea	0.679
13 India	0.605
14 Trinidad and Tobago	0.591
15 Belize	0.545
16 Suriname	0.538
17 French Guiana	0.536
17 Costa Rica	0.536
19 Honduras	0.533
20 Panama	0.500
20 Guyana	0.500
20 Senegal	0.500
23 Guatemala	0.471
24 Nicaragua	0.469
25 Mozambique	0.467
26 Iran	0.462
26 Nepal	0.462
28 Turkey	0.438
29 Colombia	0.406
30 Kenya	0.385
31 Venezuela	0.380
32 Peru	0.375
33 Pakistan	0.364
34 Mexico	0.341
35 Brazil	0.308
36 Florida, USA	0.303
37 Tanzania	0.300
38 Canada	0.292
39 Australia	0.286
39 Angola	0.286
41 Ghana	0.273
42 Togo	0.250
42 Sudan	0.250
44 United States of America	0.205
45 South Africa	0.192
46 Congo (Democratic Republic of the Congo)	0.139
47 Argentina	0.136
47 Bolivia	0.136
49 Namibia	0.115
50 Nigeria	0.091
51 Uganda	0.000

This small group of turtle-rich nations was analyzed based on their HDI group ranking (developed, developing, or underdeveloped) (Table 7). The mean for average threat level for developed nations ($n=9$) was 0.354, for developing nations ($n=33$) it was 0.538, and for underdeveloped nations ($n=8$) it was 0.360. The average threat level in developed nations differed significantly from that in developing nations (Table 7), and in developing nations it differed significantly from underdeveloped nations, but developed and underdeveloped nations were not significantly different.

Mean total threat levels differed significantly among all three HDI developmental categories (Table 7); diversity and total endemism differed significantly only between developing and underdeveloped nations; percent endemism was not significantly different among any categories. The differences observed in threat levels between developmental categories were not apparently due to differences in turtle

Table 7. Significance levels (two-tailed t-tests) comparing degree of economic development (HDI) per nation with turtle diversity, endemism, and threat levels. Analysis for 50 nations with ≥ 10 taxa (see Table 6). Developed (Dd) nations, $n=9$; developing (Dg), $n=33$; underdeveloped (Ud), $n=8$. * = significant at $t < 0.05$.

	mean	comparison	t-test
Diversity			
Developed (Dd)	32.667	Dd vs Dg	0.9563
Developing (Dg)	19.788	Dd vs Ud	0.0535
Underdeveloped (Ud)	13.875	Dg vs Ud	0.0001 *
Total Endemism			
Developed (Dd)	15.111	Dd vs Dg	0.2336
Developing (Dg)	2.273	Dd vs Ud	0.1018
Underdeveloped (Ud)	1.375	Dg vs Ud	0.0125 *
Percent Endemism			
Developed (Dd)	0.268	Dd vs Dg	0.5440
Developing (Dg)	0.083	Dd vs Ud	0.2742
Underdeveloped (Ud)	0.096	Dg vs Ud	0.2635
Average Threat Level			
Developed (Dd)	0.354	Dd vs Dg	0.0014 *
Developing (Dg)	0.538	Dd vs Ud	0.8013
Underdeveloped (Ud)	0.360	Dg vs Ud	0.0067 *
Total Threat Level			
Developed (Dd)	9.944	Dd vs Dg	0.0085 *
Developing (Dg)	11.864	Dd vs Ud	0.0380 *
Underdeveloped (Ud)	4.938	Dg vs Ud	0.0003 *

diversity or endemism, except perhaps when comparing developing with underdeveloped nations.

The same analysis for all HDI-ranked nations with any turtles (≥ 1 taxon) yielded similar but less significant results: the mean for average threat level for developed nations ($n=40$) was 0.405, for developing nations ($n=74$) it was 0.500, and for underdeveloped nations ($n=32$) it was 0.262. The average threat level in developed nations did not differ significantly from that in developing nations ($p=0.126$), but in developing nations it differed significantly from underdeveloped nations ($p=0.006$), and developed and underdeveloped nations were not significantly different ($p=0.398$).

Based on these data, it appears that socially and economically underdeveloped nations have relatively low threat levels per turtle taxon, developing nations have very high threat levels per turtle taxon, and developed nations intermediate threat levels.

Discussion. — This analysis has demonstrated how remarkably diverse and globally important Florida's turtles are. Florida ranks among the world's most important areas for turtles, with very high diversity, endemism, and density of taxa, being listed at or near the top in all categories.

At the same time, Florida's turtles are facing increasing threats from physical development, primarily rapid urbanization and habitat loss. The threat levels to Florida's turtles place them at moderate to high levels of global prioritization for turtle conservation action. Florida's turtle fauna is not yet as threatened as in Asia, where massive direct exploitation coupled with habitat loss have combined to reduce those turtle faunas to mere remnants of their former abundance. However, if habitat loss and other threats in Florida are not addressed, the threat levels here will continue to increase. Fortunately, at this time, Florida's turtles are still abundant enough that, with appropriate conservation action, we should be able to successfully preserve them into the future.

The analysis of correlation between turtle threat levels and human social and economic development (HDI) demon-

strated that “developing” nations tend to have more highly threatened turtles than either “developed” or “underdeveloped” nations. In general, the initial “developing” expansion of human social and economic development is usually associated with increased exploitation of turtles by growing human populations, as in Asia (van Dijk et al., 2000) and Africa (Lawson, 2000; Luiselli et al., 2006), leading to unsustainable use. As developing countries become more economically developed, a gradual shift occurs away from subsistence utilization of turtles towards alternate sources of protein, leading to lesser direct threats on turtle populations (though those threats are often replaced by loss of habitat and urbanization caused by industrial and community development). Threats in developing nations come first as part of a general liquidation of resources for development, protection follows as the situation settles into a secure, developed context. The speed and intensity of these processes determine whether turtles weather the storm or are eliminated faster than they are protected (P.P. van Dijk, *pers. comm.*).

What this analysis also showed is that there appears to be what one might call a “dilemma of development.” The dilemma is that depending on how one defines the term “development” it can either threaten or help to protect turtles. Physical development, such as is occurring in Florida with urbanization and habitat loss, threatens turtles, but human social and economic development may help engender improved protection for threatened turtles through an enhanced public conservation ethic and recognition of the importance of adequate native habitats and protected areas and decreased exploitation of native species.

In terms of comparing the two methods of prioritization for turtle conservation, I believe Method B offers a more meaningful way of identifying those nations where the greatest conservation needs would benefit the most from focused conservation efforts. However, political will and available opportunities usually drive the selection process.

Conclusions. — The bottom line here is that Florida is a very special place for turtles when one places it in the global context of what the rest of the world has to offer. The human residents of Florida are indeed fortunate to be living in this global epicenter of high turtle richness and density, where threat levels are still relatively moderate, providing opportunities to enjoy these animals in the wild, both in community-based habitats and conservation-focused protected areas. Though physical development and urbanization with habitat loss threaten many of the species here, the levels of threats are still comparatively moderate on a global scale. This should be cause for celebration as well as continued vigilance and advocacy lest those development pressures push turtles into higher and higher threat levels, from which they may never recover.

We do not wish Florida’s landscape to become devoid of turtles, where the only turtles we would ever see would be in zoos and special exhibits and a few protected areas. We need turtles in our midst in their native habitats and it is our responsibility to keep them there. Let us not allow to happen here what has already happened in that other major epicenter

of turtle richness, Asia, where overwhelming threats to turtles have tipped the balance to the point where hardly anyone ever sees a wild turtle anymore.

Acknowledgments. — I thank Peter Meylan, Peter Paul van Dijk, and Bryan Stuart for insightful reviews and commentaries on earlier versions of this manuscript.

LITERATURE CITED

- ENGE, K.M., BERISH, J.E., BOLT, R., DZIERGOWSKI, A., AND MUSHINSKY, H.R. 2006. Biological status report—gophertortoise (*Gopherus polyphemus*). Tallahassee, FL: Florida Fish and Wildlife Conservation Commission, 60 pp. <http://www.myfwc.com/imperiledspecies/reports/Gopher-Tortoise-BSR.pdf>.
- FRITZ, U. AND HAVAS, P. In review. CITES checklist of chelonians of the world. Submitted to CITES.
- GERLACH, J. 1997. Seychelles Red Data Book—1997. Victoria, Seychelles: The Nature Protection Trust of Seychelles, 130 pp.
- GERLACH, J. 2004. Giant Tortoises of the Indian Ocean. The genus *Dipsochelys* inhabiting the Seychelles Islands and the extinct giants of Madagascar and the Mascarenes. Frankfurt: Edition Chimaira, 207 pp.
- IUCN. 2001. IUCN Red List Categories and Criteria: Version 3.1. Gland, Switzerland: IUCN Species Survival Commission, 30 pp.
- IUCN. 2006. 2006 IUCN Red List of Threatened Species. <http://www.redlist.org>.
- IVERSON, J.B. 1992. A Revised Checklist with Distribution Maps of the Turtles of the World. Richmond, IN: Privately printed, 363 pp.
- IVERSON, J.B. 2006. A Checklist of the Turtles of the World. <http://www.earlham.edu/biology/documents/Checklist/pdf>.
- LAWSON, D.P. 2000. Local harvest of hingeback tortoises, *Kinixys erosa* and *K. homeana*, in southwestern Cameroon. *Chelonian Conservation and Biology* 3(4):722-729.
- LUISELLI, L., POLITANO, E., AND LEA, J. 2006. Assessment of the Vulnerable status of *Kinixys homeana* (Testudines: Testudinidae) for the IUCN Red List. *Chelonian Conservation and Biology* 5(1):130-138.
- PRITCHARD, P.C.H. 1996. The Galápagos Tortoises: Nomenclatural and Survival Status. *Chelonian Research Monographs* No. 1, 85 pp.
- REYNOLDS, J.E. 2001. Urbanization and land use change in Florida and the South. In: Bergstrom, J.C. (Ed.). *Current Issues Associated with Land Values and Land Use Planning. Proceedings of a Regional Workshop.* Southern Rural Development Center, pp. 28-49. http://srcd.msstate.edu/publications/220_ch2.pdf.
- STUART, B.L. AND THORBJARNARSON, J. 2003. Biological prioritization of Asian countries for turtle conservation. *Chelonian Conservation and Biology* 4(3):642-647.
- TFTSG AND ATTWG (IUCN/SSC TORTOISE AND FRESHWATER TURTLE SPECIALIST GROUP AND ASIAN TURTLE TRADE WORKING GROUP). 2000. Recommended changes to 1996 IUCN Red List status of Asian turtle species. In: van Dijk, P.P., Stuart, B.L., and Rhodin, A.G.J. (Eds.). *Asian Turtle Trade: Proceedings of a Workshop on Conservation and Trade of Freshwater Turtles and Tortoises in Asia.* *Chelonian Research Monographs* 2:156-164.
- TTWG (TURTLE TAXONOMY WORKING GROUP). In review. A list of modern turtle terminal taxa (with comments on areas of instability and recent change). Submitted to *Chelonian Research Monographs*.
- UNDP (UNITED NATIONS DEVELOPMENT PROGRAMME). 2005. Human Development Report 2005. <http://hdr.undp.org/reports/global/2005>.
- VAN DIJK, P.P., STUART, B.L., AND RHODIN, A.G.J. (Eds.). 2000. *Asian Turtle Trade: Proceedings of a Workshop on Conservation and Trade of Freshwater Turtles and Tortoises in Asia.* *Chelonian Research Monographs* No. 2, 164 pp.

APPENDIX. Data for all 155 global nations and territories (including Florida) as used in this analysis. HDI = Human Development Index; nations in green are “high development” (= developed) areas with HDI ≥ 0.80 , nations in orange are “medium development” (= developing) areas with HDI < 0.80 and ≥ 0.50 , nations in red are “low development” (= underdeveloped) areas with HDI < 0.50 , nations in black are unranked areas without adequate HDI data. Turtle richness includes all species and subspecies of freshwater turtles, tortoises, and marine turtles, living or extinct since 1500 AD ($n = 475$) currently most widely recognized as distinct (interpreted from Iverson, 1992, 2006; Fritz and Havas, in review; TTWG, in review; Rhodin, unpubl. data). Turtle density is richness per 1000 sq.km national area. Endemism is recorded as total number of endemic taxa and percent endemism. Threat level is recorded as TTL = (No. EX taxa x 3.0) + (No. EW taxa x 2.0) + (No. CR taxa x 2.0) + (No. EN taxa x 1.0) + (No. VU taxa x 0.5) or ATL = (TTL/number of taxa). Threat levels are per 2006 IUCN Red List, but adjusted for Florida as a stand-alone entity (see text). Prioritizations are sums of ranks of richness, endemism, and threat level, with Method A similar to that developed by Stuart and Thorbjarnarson (2003), ranking richness, percent endemism, and average threat level, and Method B different, ranking richness, total endemism, and total threat level. Nations in italics have lost all their native non-marine turtle taxa to extinction.

	HDI	sq. km.	Turtle Richness	Turtle Density	Endemism		Threat Level		Prioritization	
					Total	Percent	Total	Average	A	B
Afghanistan	—	652,225	2	0.003	0	0.00%	1.0	0.500	292.0	242.0
Albania	0.780	28,703	6	0.209	0	0.00%	3.0	0.500	243.0	160.5
Algeria	0.722	2,381,741	5	0.002	0	0.00%	2.0	0.400	276.5	190.0
Angola	0.445	1,246,700	14	0.011	0	0.00%	4.0	0.286	226.5	91.5
Argentina	0.863	2,780,092	11	0.004	2	18.18%	1.5	0.136	177.0	139.0
Armenia	0.759	29,743	4	0.134	0	0.00%	1.0	0.250	316.5	221.5
Australia	0.955	7,692,030	42	0.005	35	83.33%	12.0	0.286	100.5	19.5
Austria	0.936	83,858	1	0.012	0	0.00%	0.0	0.000	387.0	288.0
Azerbaijan	0.729	86,600	4	0.046	0	0.00%	1.0	0.250	316.5	221.5
Bahamas	0.832	13,939	6	0.430	1	16.67%	6.5	1.083	121.5	127.5
Bahrain	0.846	694	5	7.205	0	0.00%	6.0	1.200	208.0	150.0
Bangladesh	0.520	147,570	25	0.169	1	4.00%	17.5	0.700	90.5	27.0
Belarus	0.786	207,595	1	0.005	0	0.00%	0.0	0.000	387.0	288.0
Belize	0.753	22,965	11	0.479	0	0.00%	6.0	0.545	188.5	91.0
Benin	0.431	114,760	8	0.070	0	0.00%	4.0	0.500	222.0	127.0
Bolivia	0.687	1,098,581	11	0.010	0	0.00%	1.5	0.136	255.0	139.0
Bosnia and Herzegovina	0.786	51,129	4	0.078	0	0.00%	0.0	0.000	354.0	255.0
Botswana	0.565	581,730	9	0.015	0	0.00%	0.0	0.000	295.0	196.0
Brazil	0.792	8,547,404	39	0.005	11	28.21%	12.0	0.308	106.0	20.5
Brunei	0.866	5,765	7	1.214	0	0.00%	4.5	0.643	211.5	130.5
Bulgaria	0.814	287,413	4	0.014	0	0.00%	0.5	0.125	328.5	232.5
Burkina Faso	0.317	274,400	5	0.018	0	0.00%	0.5	0.100	318.5	220.0
Burundi	0.378	27,816	5	0.180	0	0.00%	0.0	0.000	341.5	242.5
Cambodia	0.571	181,035	14	0.077	0	0.00%	11.0	0.786	157.0	50.0
Cameroon	0.497	475,442	7	0.015	0	0.00%	0.5	0.071	295.0	191.0
Canada	0.949	9,970,610	12	0.001	0	0.00%	3.5	0.292	234.0	105.5
Cayman Islands	—	260	3	11.538	0	0.00%	2.0	0.667	261.0	212.5
Central African Republic	0.355	622,436	6	0.010	0	0.00%	0.0	0.000	325.5	226.5
Chad	0.341	1,284,000	6	0.005	0	0.00%	0.5	0.083	305.5	204.0
China (People's Republic of China)	0.755	9,572,900	29	0.003	9	31.03%	38.5	1.328	27.0	12.0
Colombia	0.785	1,141,568	32	0.028	3	9.38%	13.0	0.406	116.0	22.0
Congo (Democratic Republic of the Congo)	0.385	2,344,858	18	0.008	1	5.56%	2.5	0.139	169.0	99.5
Congo (Republic of the Congo)	0.512	342,000	7	0.020	0	0.00%	0.0	0.000	312.5	213.5
Costa Rica	0.838	51,100	14	0.274	0	0.00%	7.5	0.536	177.5	61.0
Croatia	0.841	56,542	4	0.071	0	0.00%	0.0	0.000	354.0	255.0
Cuba	0.817	110,861	6	0.054	1	16.67%	6.0	1.000	126.5	134.0
Cyprus	0.891	9,251	3	0.324	0	0.00%	2.0	0.667	261.0	212.5
Czech Republic	0.874	204,260	1	0.005	0	0.00%	0.0	0.000	387.0	288.0
Djibouti	0.495	23,200	1	0.043	0	0.00%	0.5	0.500	304.5	265.5
Dominican Republic	0.749	126,060	6	0.048	0	0.00%	6.5	1.083	196.5	127.5
Ecuador	0.759	272,045	28	0.103	10	35.71%	22.5	0.804	47.0	20.0
Egypt	0.659	997,690	6	0.006	0	0.00%	4.0	0.667	222.5	148.0
El Salvador	0.722	21,041	6	0.285	0	0.00%	3.0	0.500	243.0	160.5
Equatorial Guinea	0.655	28,051	6	0.214	0	0.00%	3.5	0.583	230.0	153.0
Eritrea	0.444	121,100	9	0.074	0	0.00%	7.5	0.833	177.0	87.0
Estonia	0.853	43,431	1	0.023	0	0.00%	0.0	0.000	387.0	288.0
Ethiopia	0.367	1,133,882	7	0.006	0	0.00%	0.5	0.071	295.0	191.0
Florida, USA	0.944	170,306	38	0.223	9	23.68%	11.5	0.303	109.5	23.5
France	0.938	543,965	6	0.011	1	16.67%	2.0	0.333	198.5	174.0
French Guiana	—	86,504	14	0.162	0	0.00%	7.5	0.536	177.5	61.0
Gabon	0.635	267,667	8	0.030	1	12.50%	0.0	0.000	235.5	205.5
Gambia	0.470	10,689	7	0.655	0	0.00%	0.0	0.000	312.5	213.5
Georgia	0.732	69,700	5	0.072	0	0.00%	2.5	0.500	259.0	185.0
Germany	0.930	357,021	1	0.003	0	0.00%	0.0	0.000	387.0	288.0
Ghana	0.523	238,533	11	0.046	0	0.00%	3.0	0.273	241.5	117.5
Greece	0.912	131,957	6	0.045	0	0.00%	1.5	0.250	288.0	182.0
Guatemala	0.663	108,889	17	0.156	0	0.00%	8.0	0.471	182.0	45.5
Guinea	0.466	245,857	5	0.020	0	0.00%	0.0	0.000	341.5	242.5
Guinea-Bissau	0.348	36,125	4	0.111	0	0.00%	0.0	0.000	354.0	255.0
Guyana	0.720	215,083	14	0.065	0	0.00%	7.0	0.500	186.5	66.0
Haiti	0.475	27,700	6	0.217	0	0.00%	6.5	1.083	196.5	127.5
Honduras	0.667	112,492	15	0.133	0	0.00%	8.0	0.533	173.5	52.0
Hungary	0.862	93,030	1	0.011	0	0.00%	0.0	0.000	387.0	288.0
India	0.602	3,166,414	38	0.012	7	18.42%	23.0	0.605	65.5	11.5
Indonesia	0.697	1,922,570	36	0.019	5	13.89%	30.5	0.847	56.0	9.5
Iran	0.736	1,629,918	13	0.008	2	15.38%	6.0	0.462	130.5	83.5
Iraq	—	435,052	5	0.011	0	0.00%	1.5	0.300	295.0	198.0
Israel	0.915	20,425	8	0.392	0	0.00%	6.5	0.813	189.0	106.5
Italy	0.934	301,277	9	0.030	3	33.33%	4.0	0.444	136.5	117.5
Ivory Coast (Cote d'Ivoire)	0.420	322,463	9	0.028	0	0.00%	3.0	0.333	243.0	130.0
Jamaica	0.738	10,991	4	0.364	0	0.00%	4.5	1.125	223.0	172.0

	HDI	sq. km.	Turtle Richness	Turtle Density	Endemism		Threat Level		Prioritization	
					Total	Percent	Total	Average	A	B
Japan	0.943	377,837	9	0.024	4	44.44%	8.5	0.944	81.5	82.0
Jordan	0.753	89,342	2	0.022	0	0.00%	0.0	0.000	374.5	275.5
Kazakhstan	0.761	2,724,900	4	0.001	0	0.00%	1.5	0.375	295.0	210.5
Kenya	0.474	582,646	13	0.022	1	7.69%	5.0	0.385	150.5	90.0
Kuwait	0.844	17,818	2	0.112	0	0.00%	1.0	0.500	292.0	242.0
Kyrgyzstan	0.702	199,900	2	0.010	0	0.00%	1.0	0.500	292.0	242.0
Laos	0.545	236,800	16	0.068	0	0.00%	13.0	0.813	144.0	35.5
Latvia	0.836	64,589	1	0.015	0	0.00%	0.0	0.000	387.0	288.0
Lebanon	0.759	10,400	5	0.481	0	0.00%	2.5	0.500	259.0	185.0
Lesotho	0.497	30,355	2	0.066	0	0.00%	0.0	0.000	374.5	275.5
Liberia	—	97,754	7	0.072	0	0.00%	3.0	0.429	245.0	147.5
Libya	0.799	1,757,000	5	0.003	1	20.00%	4.0	0.800	147.0	164.0
Lithuania	0.852	65,300	1	0.015	0	0.00%	0.0	0.000	387.0	288.0
Macedonia	0.797	25,713	4	0.156	0	0.00%	0.5	0.125	328.5	232.5
Madagascar	0.499	587,041	14	0.024	8	57.14%	10.0	0.714	68.0	52.0
Malawi	0.404	118,484	8	0.068	0	0.00%	0.0	0.000	304.5	205.5
Malaysia	0.796	329,845	23	0.070	0	0.00%	21.5	0.935	134.0	25.5
Maldives	0.745	298	3	10.067	0	0.00%	3.0	1.000	240.0	199.0
Mali	0.333	1,248,574	6	0.005	0	0.00%	0.5	0.083	305.5	204.0
Mauritania	0.477	1,030,700	5	0.005	0	0.00%	1.5	0.300	295.0	198.0
Mauritius (incl. Rodrigues)	0.791	2,040	5	2.451	4	80.00%	13.0	2.600	106.5	117.5
Mexico	0.814	1,964,375	63	0.032	31	49.21%	21.5	0.341	93.0	10.5
Moldova	0.671	33,700	1	0.030	0	0.00%	0.0	0.000	387.0	288.0
Morocco	0.631	710,850	9	0.013	4	44.44%	3.5	0.389	139.5	122.5
Mozambique	0.379	812,379	15	0.018	0	0.00%	7.0	0.467	190.5	60.5
Myanmar	0.578	676,577	30	0.044	7	23.33%	27.0	0.900	43.0	13.0
Namibia	0.627	825,118	13	0.016	1	7.69%	1.5	0.115	189.5	131.5
Nepal	0.526	147,181	13	0.088	0	0.00%	6.0	0.462	203.5	83.5
Nicaragua	0.690	130,373	16	0.123	0	0.00%	7.5	0.469	185.5	51.5
Niger	0.281	1,186,408	3	0.003	0	0.00%	0.5	0.167	332.5	242.5
Nigeria	0.453	923,768	11	0.012	0	0.00%	1.0	0.091	260.5	150.0
North Korea	—	122,762	2	0.016	0	0.00%	1.5	0.750	265.5	231.0
Pakistan	0.527	796,095	11	0.014	1	9.09%	4.0	0.364	163.5	105.0
Panama	0.804	74,979	15	0.200	0	0.00%	7.5	0.500	181.0	55.5
Papua New Guinea	0.523	462,840	14	0.030	1	7.14%	9.5	0.679	104.0	54.0
Paraguay	0.755	406,752	6	0.015	0	0.00%	0.5	0.083	305.5	204.0
Peru	0.762	1,285,216	16	0.012	0	0.00%	6.0	0.375	200.5	68.0
Philippines	0.758	300,076	9	0.030	1	11.11%	9.5	1.056	102.0	80.0
Poland	0.858	312,685	1	0.003	0	0.00%	0.0	0.000	387.0	288.0
Portugal	0.904	92,365	2	0.022	0	0.00%	0.0	0.000	374.5	275.5
Puerto Rico	—	9,104	5	0.549	1	20.00%	6.0	1.200	126.5	150.0
Réunion	—	2,507	3	1.197	1	33.33%	6.0	2.000	138.5	172.5
Romania	0.792	237,500	3	0.013	0	0.00%	0.5	0.167	332.5	242.5
Russia	0.796	17,075,400	7	0.000	1	14.29%	3.0	0.429	173.5	147.5
Rwanda	0.450	26,338	6	0.228	0	0.00%	0.0	0.000	325.5	226.5
São Tomé and Príncipe	0.604	1,001	3	2.997	0	0.00%	1.0	0.333	312.0	231.5
Saudi Arabia	0.772	2,248,000	5	0.002	0	0.00%	3.0	0.600	243.5	176.5
Senegal	0.458	196,712	11	0.056	0	0.00%	5.5	0.500	200.0	95.5
Seychelles	0.821	455	9	19.780	7	77.78%	17.5	1.944	63.0	68.5
Sierra Leone	0.298	71,740	8	0.112	0	0.00%	3.0	0.375	245.5	139.5
Singapore	0.907	683	8	11.713	0	0.00%	5.0	0.625	204.5	119.5
Slovakia	0.849	49,035	1	0.020	0	0.00%	0.0	0.000	387.0	288.0
Slovenia	0.904	20,273	2	0.099	0	0.00%	0.0	0.000	374.5	275.5
Somalia	—	637,000	8	0.013	0	0.00%	3.0	0.375	245.5	139.5
South Africa	0.658	1,219,090	26	0.021	6	23.08%	5.0	0.192	135.0	67.0
South Korea	0.901	99,461	2	0.020	0	0.00%	1.5	0.750	265.5	231.0
Spain	0.928	505,990	7	0.014	1	14.29%	2.5	0.357	186.0	156.0
Sri Lanka	0.751	65,610	9	0.137	1	11.11%	7.0	0.778	118.0	92.0
Sudan	0.512	2,503,890	10	0.004	0	0.00%	2.5	0.250	250.5	131.5
Suriname	0.755	163,820	13	0.079	0	0.00%	7.0	0.538	182.0	72.0
Swaziland	0.498	17,364	6	0.346	0	0.00%	0.0	0.000	325.5	226.5
Switzerland	0.947	41,284	1	0.024	0	0.00%	0.0	0.000	387.0	288.0
Syria	0.721	185,180	6	0.032	0	0.00%	3.5	0.583	230.0	153.0
Taiwan (Republic of China)	0.910	36,188	9	0.249	1	11.11%	10.5	1.167	97.0	77.0
Tajikistan	0.652	143,100	2	0.014	0	0.00%	1.0	0.500	292.0	242.0
Tanzania	0.418	942,799	15	0.016	1	6.67%	4.5	0.300	158.0	81.5
Thailand	0.778	513,115	29	0.057	0	0.00%	24.0	0.828	132.0	16.0
Timor Leste (East Timor)	0.513	14,609	2	0.137	0	0.00%	1.5	0.750	265.5	231.0
Togo	0.512	56,785	10	0.176	0	0.00%	2.5	0.250	248.0	131.5
Trinidad and Tobago	0.801	5,128	11	2.145	0	0.00%	6.5	0.591	185.5	84.5
Tunisia	0.753	164,150	4	0.024	0	0.00%	1.5	0.375	295.0	210.5
Turkey	0.750	779,452	16	0.021	3	18.75%	7.0	0.438	110.5	56.5
Turkmenistan	0.738	488,100	5	0.010	0	0.00%	1.5	0.300	295.0	198.0
Uganda	0.508	241,038	10	0.041	0	0.00%	0.0	0.000	288.0	189.0
Ukraine	0.766	603,700	3	0.005	0	0.00%	0.5	0.167	332.5	242.5
United States of America (including Florida)	0.944	7,710,721	88	0.011	59	67.05%	18.0	0.205	109.0	11.0
Uruguay	0.840	176,215	6	0.034	0	0.00%	1.0	0.167	294.0	193.0
Uzbekistan	0.694	447,400	2	0.004	0	0.00%	1.0	0.500	292.0	242.0
Venezuela	0.772	916,445	25	0.027	3	12.00%	9.5	0.380	123.5	38.5
Vietnam	0.704	331,041	29	0.088	5	17.24%	30.5	1.052	46.0	13.5
Yemen	0.489	472,099	3	0.006	0	0.00%	3.0	1.000	240.0	199.0
Yugoslavia (Serbia and Montenegro)	—	102,173	4	0.039	0	0.00%	0.0	0.000	354.0	255.0
Zambia	0.394	752,614	8	0.011	0	0.00%	0.0	0.000	304.5	205.5
Zimbabwe	0.505	390,757	9	0.023	0	0.00%	0.0	0.000	295.0	196.0