

Status of the World's Tortoises and Freshwater Turtles

a summary overview
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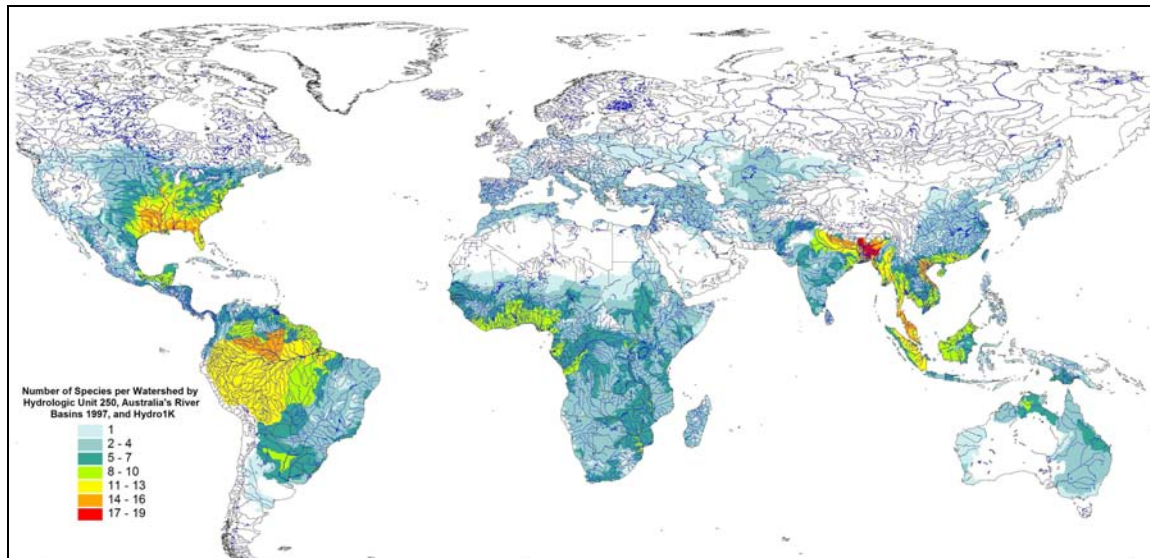


Eastern Box Turtle (*Terrapene carolina carolina*), a widespread species in the eastern United States whose populations are fading away as lands are fragmented by roads and occupied by residential and other developments. Adult male relocated from Inter-County Connector highway project site, 8 November 2009.

Some 350 species of **tortoises and freshwater turtles** exist on Earth, representatives of a lineage dating back to the dawn of the age of dinosaurs. While not as obviously visible as birds or ecologically dominant as large mammals or fish, turtles often fulfill important roles in the ecosystem, including seed dispersal and vegetation management, control of insect and snail populations, and keeping water clean and populations healthy by scavenging dead animals and preying on weak and sick individuals. Turtles and tortoises also feature prominently in human culture and legends, and are eaten in some human societies.

Turtles evolved a life strategy characterized by slow growth and late maturity (usually on the order of 10-15 years), longevity (typically living for sixty or more years) and successful reproduction throughout life without senility, relatively modest annual reproductive output (one to over 100 eggs per mature female per year, depending on species), very low survivorship of eggs and juveniles, but increasingly high average annual survivorship of subadults and adults. In short, the key to turtle life history is to reach maturity, live for a long time, and produce a modest number of eggs each year, so that over a lifetime enough eggs are produced to ensure that a few will successfully hatch and some of these will survive to adulthood.

While the solid shell of most adult turtles effectively deters predation by almost all species, humans can be an exceptionally effective predator of turtles by the use of tools, fire and intelligence. Tortoises formed a significant part of the diet of Neanderthals, prehistoric cave-dwelling Cro-Magnons, and nearly all subsistence hunter-gatherer societies living where turtles occur. As human societies developed, so did pressures on turtle populations, with present-day impacts as never before. Across Asia, tortoises and freshwater turtles continue to be collected for commercial export to China, where turtles are esteemed for consumption for their perceived medicinal benefits. Collagen from turtles shells is becoming a sought-after ingredient in cosmetic products. Turtles are also popular as pets, and particularly attractive or rare species can command high prices. Turtle farming can go some way to meet these demands, but as long as it is cheaper to collect and transport wild turtles than to produce them on farms, wild collection will continue, usually breaking protective laws if such exist.



Species Richness map of the world's tortoises and freshwater turtles; preliminary version of Buhlmann et al., 2009, *Chelonian Conservation and Biology*

In addition, tortoises and freshwater turtles suffer from habitat degradation and loss in all its various forms, including deforestation, draining wetlands, converting clearwater rivers to stagnant multi-purpose reservoirs, and mortality on roads when turtles move around to feed and nest. introduced invasive species impact turtles directly and indirectly.

Despite the gravity of these threats, only nine species of turtles have gone extinct between 1500 AD and the present; most of these were giant tortoise species on Mauritius and other Indian Ocean Islands. Several species feared extinct only a decade ago have been rediscovered in recent years through targeted coordinated surveys, and heroic efforts are made to secure and expand the remnant populations of these and other turtle species.

Evaluating the conservation status of the world's tortoises and freshwater turtles

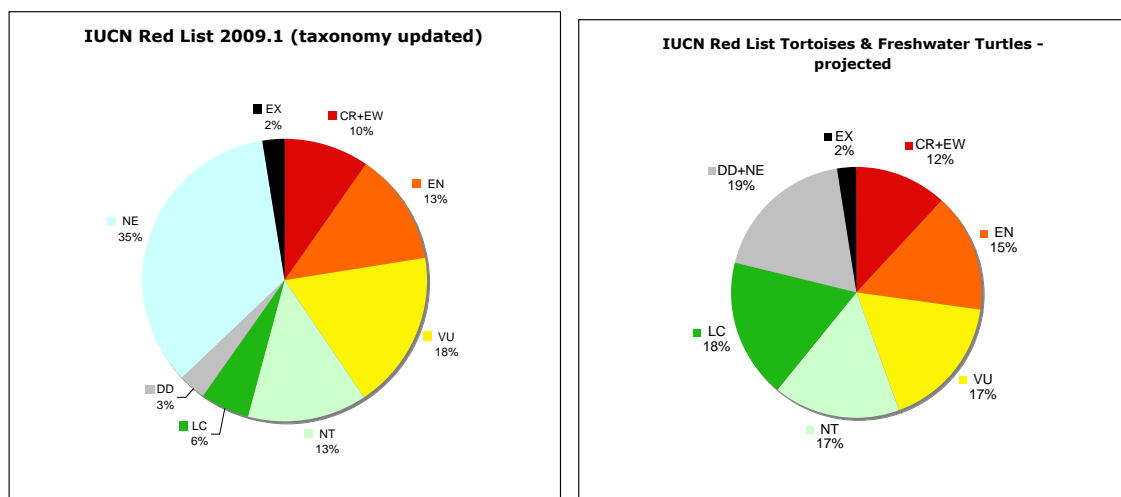
The IUCN Red List of Threatened Species is the world standard to evaluate the conservation outlook of species. As Red List Focal Point for the IUCN/SSC's Tortoise and Freshwater Turtle Specialist Group, Peter Paul van Dijk leads the evaluation process for the approximately 350 species of TFT. Through literature review and seeking expert expertise, each species is assessed for its historical population trends, current threats, and current and additional needed conservation efforts, to arrive at a standardized classification of its conservation status, ranging from Critically Endangered to Least Concern, which is accessible at <http://www.iucnredlist.org>. Further analysis elucidates patterns of threat, geographic as well as thematic, and these findings are directly applied to conservation strategies developed by the Turtle Conservation Fund and partners, by Conservation International and other NGOs, and by government authorities where possible.

The current 2009 IUCN Red List includes evaluations for 212 turtle species. Of these, 7 are Extinct (EX), 1 Extinct in the Wild (EW), 30 Critically Endangered (CR), 42 Endangered (EN), 59 Vulnerable (VU), 43 Near Threatened (NT) or Conservation Dependent (LR/cd; an old category being phased out), 19 Least Concern (LC), and 11 Data

Deficient (DD). By IUCN protocol, threatened species are defined as those in the three categories CR, EN, and VU, meaning 131 species are threatened, representing 61.8% of the 212 species listed as evaluated.

Of the 333 species currently recognized as distinct¹ (Turtle Taxonomy Working Group, 2009), 118 are not yet formally included on the 2009 Red List. Most of these "unevaluated" species have in fact been provisionally evaluated by the TFTSG, first in 1996 when all turtles were evaluated under the older IUCN criteria, but LC species were not formally listed, and then recently through an ongoing series of regional Red Listing workshops held by the TFTSG. Although the 1996 evaluations need updating, and the workshop evaluations are still provisional, we can use the preliminary determinations to predict overall threat rates to turtles. Of the 118 currently "unevaluated" turtle species, we provisionally consider most (82) as LC or NT, with only 10 provisionally considered threatened (CR, EN, or VU), and 25 considered DD, with one, *Chelonoidis phantastica*, considered EX.

If we add the provisional evaluations of the 118 species whose evaluations are in progress, this yields 10 more threatened species, or 144 total threatened species, or 43.2% of all 333 currently recognized modern turtle species. Similarly, many of the current Red List evaluations are being updated, and some species will move from non-threatened into threatened categories, or vice versa. If we include these draft status changes and add them to the mix, then provisionally there are 152 threatened species (45.6%), or 161 threatened plus EW and EX species, or 48.3% of all modern turtles either extinct or threatened with extinction.



No matter how we analyze these various percentages of threatened species, turtles are among the most threatened of any major group of vertebrate species, more than birds (ca. 12%), mammals (ca. 21-25%), or amphibians (32%) (www.iucnredlist.org).

¹ Turtle Taxonomy Working Group [Rhodin, A.G.J., Parham, J.F., van Dijk, P.P., and Iverson, J.B.]. 2009. Turtles of the world: annotated checklist of taxonomy and synonymy, 2009 update, with conservation status summary. In: Rhodin, A.G.J., Pritchard, P.C.H., van Dijk, P.P., Saumure, R.A., Buhlmann, K.A., Iverson, J.B., and Mittermeier, R.A. (Eds.). *Conservation Biology of Freshwater Turtles and Tortoises: A Compilation Project of the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group*. Chelonian Research Monographs No. 5, pp. 000.39–000.84, doi:10.3854/crm.5.000.checklist.v2.2009, <http://www.iucn-tftsg.org/cbftt/>.

The World's Most Threatened Turtles

In 2003, The Turtle Conservation Fund (TCF) compiled a list of the 25 most threatened turtle species in the world (<http://www.turtleconservationfund.org/top-25/>, also attached to this document). Since then, the conservation status of a few species has improved, or further fieldwork has shown that the initial threat assessment was based on incomplete data, while the conservation status of other species is known to have deteriorated. The TCF re-evaluated the top 25 in 2008-2009, and while some changes were indicated, no revised list has been published to date. The following are short summaries of the status and priority actions for the most threatened species:

Red River or Yangtze Giant Softshell Turtle, *Rafetus swinhoei* – China & Viet Nam – CR

Rafetus swinhoei is a softshell turtle sized like a small coffee table, and is down to four remaining individuals. One has lived for decades in the lake in downtown Hanoi, another lives in a wetland west of Hanoi, and the remaining two currently reside together in the Changsha Zoo in China after decades of living in separate facilities in China. The two Chinese animals are a male and female; they were brought together in 2008, the culmination of years of work by WCS China, Turtle Survival Alliance and Chinese authorities. Eggs were produced, but died during incubation. Recent intensive surveys in Yunnan, China, showed evidence of *Rafetus* encounters in the past decade or two, and one or more individuals could still survive in the wild there.

The two Vietnamese animals are both believed to be males. The Asian Turtle Conservation Network has worked tirelessly over the past decade to survey suitable wetlands for surviving wild individuals (and found the 4th animal as a result), and working with local communities and authorities on turtle conservation awareness. This paid off greatly when the wetland west of Hanoi broke its dam last year and the turtle was caught about 10 km downriver; the existing awareness enabled the turtle to be retrieved from the fisherman and released into its (repaired) wetland unharmed.

Priority actions for the species include 1) continue working with Changsha Zoo towards successful reproduction of the two captive Chinese animals, and eventually develop a re-introduction program for the species; 2) continue survey and awareness work in Yunnan and northern Viet Nam where possibly another individual could be located in the wild and possibly brought together with the last known wild animal, as well as keep up vigilance on behalf of that last wild individual.

Ploughshare Tortoise, *Astrochelys yniphora* – Madagascar – CR

A large and strikingly beautiful tortoise restricted to a single population of ca. 200 animals at Baly Bay, a small nominally protected National Park in northwestern Madagascar. Individuals are valued at about USD10,000 each on the black market as pets, creating a great incentive to poach the remaining animals. A captive breeding facility, operated by Durrell Wildlife Conservation Trust, exists at Ampijoroa, Madagascar, and a re-introduction program has been in progress in Baly Bay. There used to be research and enforcement presence in the National Park, but this ceased a number of years ago. Local enforcement capacity is limited and under pressure from poachers. Behler Chelonian Center (in California) and Turtle Survival Alliance are poised to support increased conservation efforts with expertise and funding.

Priority actions are 1) re-instating effective and reliable enforcement patrols inside and outside the core protected and reintroduction areas, likely in government-NGO partnership and including making proper patrol boat(s), fuel and other resources available; 2) re-establishing a full-time on-site research program as an independent presence and monitoring system, to keep close watch on what is happening to the animals, get indications of corruption as early as possible, and by simply being in the field, act as a deterrent to poachers and any possible corrupt inclinations of rangers.

Mangrove Terrapins, *Batagur affinis* and *B. baska* – S & SE Asia – CR

Batagur baska was considered to be a single species with remnant populations from the Indian-Bangladeshi Sundarbans through Myanmar, Thailand, and Malaysia, to Sumatra and Cambodia; recent genetic work showed that the Sundarbans and Myanmar populations are the genuine *B. baska* and the Thai-Malayan animals are *Batagur affinis*; the status of Cambodian animals remains undetermined (may be a third taxon).

All these populations have gone from 100s and 10,000s of animals to remnant populations of a handful of animals per river system, with only a few Peninsular Malaysian rivers still containing maybe several dozen adults at most. Declines were driven by excessive egg collection from the predictable small nesting beaches, combined with some harvest of adult animals for local consumption in the past and trade to East Asia in recent years, combined with fisheries bycatch mortality and habitat pollution, destruction and loss. Recovery efforts have been attempted in Cambodia, India, Malaysia and Thailand, for varying lengths of time and with varying success, but these need to be substantially intensified.

Priority actions include: 1) support for the *Batagur* Conservation Center initiated by Dr. Chan in Terengganu, Malaysia, focusing initially on research, awareness, and local protection and headstarting of the still-viable Terengganu River population of *B. affinis*, eventually expanding to cover also *B. borneoensis* in this and nearby rivers, as well as expand to form a network of *Batagur* conservation expertise, support and action to other range states; 2) Surveys for remaining populations in the Sundarbans, Cambodia and Myanmar to focus conservation efforts; 3) networking among Asian *Batagur* conservation practitioners to share successes, avoid earlier mistakes, and coordinate activities.

Red-crowned River Turtle, *Batagur kachuga* – India – CR

Historically, *Batagur kachuga* (previously known as *Kachuga kachuga*) was widespread in the main riverine sections of the Ganges of India, Bangladesh and Nepal, while its occurrence in the Brahmaputra basin is shrouded in mystery indicated by varying identifications of historical museum materials. Its populations have collapsed in recent decades, apparently as a result of the combined impacts of degradation and destruction of critical nesting and feeding habitats, egg collection, consumption, entanglement in fishing nets, and pollution. Only a single substantial population is known to remain, in the National Chambal River Gharial Sanctuary covering about 220 km of the Chambal River of Madhya Pradesh, Uttar Pradesh, and Rajasthan, India; even this protected population and its habitat are under threat from sand mining, hydroelectric infrastructure plans, collection and accidental mortality.

Impressive conservation gains have been made in recent years by local conservationists with support from TSA, TCF, and San Diego Zoo, including nest protection, headstarting of some young, conversion of poachers to turtle guardians; these efforts need to be continued, the public awareness element must be expanded, and networking among Asian *Batagur* conservation practitioners to share successes, learn lessons from elsewhere, and coordinate activities, is needed.

Myanmar River Turtle, *Batagur trivittata* – Myanmar – EN (pending CR)

Nineteenth century naturalists reported great gatherings of basking River Turtles in the Ayeyarwady delta of Myanmar, with entire beaches covered by turtles. Scattered reports of the species elsewhere in Myanmar's great river systems emerged over time, until the last recorded collection on the upper Chindwin in 1935. Nothing was heard of the species again until 2001, when a single shell of a recently consumed adult was recovered, followed by the discovery of a few living animals in a Mandalay temple pond (which were then immediately transferred to Mandalay Zoo) and a few remaining adult animals in the upper Chindwin. The WCS Myanmar team located the nesting site of the remaining wild animals, and have protected nests through incubation, after which the hatchlings have been transferred to a dedicated facility at Mandalay Zoo for head-starting. This facility is reaching capacity as the juveniles grow steadily, but re-introduction to their native river area has been complicated by progressive deterioration of the river, most recently from gold mining on the nest bank as well as plans for a hydro-electric reservoir that will flood the single known nest site and alter the river's hydrology. The WCS Myanmar team continues to find practical conservation solutions in an exceptionally challenging socio-economic and political context.

Central American River Turtle, *Dermatemys mawii* – Mexico, Belize, Guatemala – CR

The only extant species of an ancient and distinct family of turtles dating back deep into geological history, *Dermatemys* is under high pressure from targeted exploitation for its highly esteemed meat. A large riverine species, it is targeted most heavily for local and regional consumption.

Priority actions include 1) local enforcement of existing protective regulations in the range countries; 2) developing, coordinating, and implementing a comprehensive, conservation and recovery strategy for the species, including among other measures a consideration of reintroduction and headstarting to bolster remaining wild populations and, possibly, managed production systems to reduce poaching pressure.

Asian Giant Softshell Turtle, *Pelochelys cantorii* – S & SE Asia – EN



The Cambodian Turtle Team is now in its third year of working with subsistence fishermen along the lower Mekong to protect nests and release hatchlings of *Pelochelys cantorii*; the program increases the number of hatchling turtles entering the Mekong, helps rural people earn an income, and creates awareness of conservation and fishery management.

This widespread species ranges from India to Java and southern China, but most populations appear to be of scattered individuals. Probably the species' best stronghold is in the middle Mekong River between Kratie and Stung Treng in northeastern Cambodia, where a pilot program by the Cambodian Turtle Team protects nests through incentive agreements with local fishermen and villagers, who are paid to protect turtle nests that would otherwise be dug up and eaten. Now in its second year, this program has already resulted in several dozen animals being released into the river, as well as increased awareness of and support for turtle and general conservation among the local communities. This is in the same general area as ongoing conservation work for River Dolphins (*Orcaella brevirostris*), with some synergies.

Future plans of the Cambodian Turtle Team include intensifying the local community incentive scheme to cover more nests along a wider stretch of the river, developing and delivering conservation awareness programs to local communities, and research into the suitability of headstarting as a conservation tool for this species; depending on the outcome of the latter study, a headstarting facility may be established at the existing dolphin viewing location where a boatmen's cooperative exists and brings about 50,000 tourists to the site per year.

Southeast Asian Giant Softshell, *Chitra chitra* – Indonesia and Thailand – CR

Arguably the most attractively patterned softshell species, *Chitra chitra* may also be the largest at a recorded maximum weight of 254 kg. Populations are known to inhabit the Mae Klong river system of Thailand, possibly some rivers in Peninsular Malaysia and Sumatra, and certainly the Solo river of eastern Java. Wherever it occurs, the species is under threat from a combination of egg harvesting (very effective as the species is predictable in its nest site selection and timing), targeted direct capture and bycatch during regular fishing activities, and riverine impacts from reservoirs altering the flow regimes of its native rivers, thus flooding nest sites, and increasing turbidity, reducing fishing efficiency of this sit-and-wait ambush feeder. The Thai Fisheries Department has a program to breed this species in captivity and release offspring into the river to augment the declining population, which initially appeared highly successful but was subsequently impacted by disease among the offspring and cessation of reproduction of the captive adults.

Priority conservation measures include reassessing the captive breeding and headstarting program in Thailand, increasing awareness and reducing local collection impacts as well as general riverine ecosystem management and rehabilitation in western Thailand (analogous to the Cambodian experience with *Pelochelys*), and applying the successful practices to the conservation of the Indonesian population.

Asian Box Turtles, genus *Cuora* – China and Viet Nam – most species CR.

Southern and central China is home to a remarkable radiation of box turtle species, many of which remain poorly known and are apparently restricted to small geographic ranges. These include the Yunnan box turtle (*Cuora yunnanensis*), thought extinct until a few individuals showed up in the pet trade, the Golden-headed box turtle (*Cuora aurocapitata*) from a small area of southern Anhui, *Cuora mccordi* allegedly from Guangxi, *Cuora zhoui* whose origin and habitat remain a mystery, and the Golden coin turtle or Three-striped box turtle (*Cuora trifasciata* complex), a species which became in insatiable demand in the 1990s as its consumption was publicized to have cancer-curing properties. In Viet Nam, all three forms of the *Cuora galbinifrons* complex (*bourreti*, *galbinifrons* and *picturata*) are localized, rare and under threat of imminent extinction. All these species command top prices in the medicinal consumption trade, as founder stock for commercial farms, and in the high-end pet trade. Conservation strategies are being developed by local and international conservationists, and while the strategy details remain to be finalized, they will include a combination of survey and research, effective protection of remnant wild populations, and maintenance of assurance colonies for eventual re-introduction into the wild once collecting pressures have subsided.

Pinta Island Tortoise, Lonesome George, *Chelonoidis (nigra) abingdonii* – Galapagos - EW

Lonesome George is the last known tortoise of the Pinta Island race in the Galapagos, collected and brought to the Charles Darwin Research station in 1973. Usually treated as a subspecies, some taxonomists consider the various Galapagos tortoises to warrant species rank, making Lonesome George the last of his species. Extensive surveys of Pinta for further individuals have failed to find any. Captive breeding efforts to cross Lonesome George with similar females from other islands have failed, but have generated enormous public interest in this species' survival prospects.

Recent genetic work on the tortoises of northern Isabela Island, however, encountered a small number of individuals with apparent F1 hybrid genes between the local Isabela tortoise, *C. n. becki*, and *C. n. abingdonii*. Subsequent historical research indicates that this may have resulted from an unloading of a deckload of tortoises off northern Isabela during a shipping altercation in the 19th century; some of those tortoises may well have been collected on Pinta, drifted ashore onto Isabela, and interbred with the local tortoises.

Priority Actions are 1) to support Adalgisa Caccone and the Yale University team working on genetics of Galapagos tortoises to screen as many tortoises as possible to identify more hybrid tortoises; and 2) move some or all of these hybrids into a managed breeding program to back-cross appropriate hybrid animals and recover the Pinta Island gene line.

Western Australian Swamp Turtle, *Pseudemydura umbrina* – Australia - CR

A small turtle exquisitely adapted to life in the ephemeral swamps of the Swan River valley of Perth, most of *Pseudemydura's* habitat was converted to wheatfields before the species was described and recognized. Less than 100 adults remained just a few years ago. The species is restricted to just two small swamps of a few hectares each, and a multi-decade captive breeding effort and intense protection through fencing and predator exclusion, headed by Gerald Kuchling, has resulted in limited reintroductions and improved survival rates in recent years, yielding a small rise in overall population size. Despite this modest, hard-won progress, the species remains under severe threat from stochastic events such as climate change with drought and bushfires, and introduced predators (foxes). Federal and State funding to continue supporting the recovery program is drying up, while increased funding is actually needed to establish additional assurance re-introduction sites at Mogumber and possibly the Perth Airport grounds.

Geometric Tortoise, *Psammobates geometricus* – South Africa – EN

A small, beautiful star-patterned tortoise that is a habitat specialist for the Renosterveld flora, unique to the Western Cape region of South Africa. About 98% of this already restricted vegetation type has been converted to agricultural usage, mainly wine production. A few small biotope preserves exist, protecting the tortoises as well as the flora, where research and practical conservation actions are implemented under the leadership of Ernst Baard of Cape Nature. The species unfortunately remains under ongoing threat from too-frequent fires, predator (fox) impacts, and climate shifts. At the same time, government funding for conservation of non-economic wildlife species is drying up in South Africa, and external funding is needed to continue ongoing efforts to safeguard this species.

Egyptian Tortoise, *Testudo kleinmanni* (incl. *T. weneri*) – Egypt, Libya, Israel - CR

This small tortoise occurs in highly localized and generally very low densities in the sand dunes and patches of desert scrub of NE Libya, coastal Egypt, the Sinai desert and adjacent Israel. Threatened by habitat loss and introduced predators, the most severe threat is illegal collection for the regional and international pet trade, despite

its CITES I status. Research and awareness work by Sherif Baha el Din , and community engagement work by Omar Attum with the Bedouin tribes in the species' range to provide sustainable income through tortoise-themed handicrafts as an alternative to collecting for the trade, deserve ongoing and increased support to intensify and expand these efforts.

Brygoo's Spider Tortoise, *Pyxis arachnoides brygooi* – SW Madagascar - CR

This small, attractive tortoise has suffered extensively from a combination of loss of its scrub and dune habitat, targeted collection for the pet trade before it was transferred from CITES Appendix II to I, and steeply increasing local consumption as local taboos and customs break down and Radiated Tortoise populations have been eaten into depletion and local extinction. Available information documents that all three Spider tortoise subspecies are affected, but the northern subspecies, *P. a. brygooi*, is by far the worst off.

Surveys in the past year by Ryan Walker and colleagues found that *brygooi* is restricted to just four extant populations, of which three are depleted and only one, on an island and nearby mainland cape, still is at reasonably high density but at high risk for exploitation. Local villagers are positive towards tortoises, and urgent action to work with the communities to empower them to keep protecting tortoises and prevent incursion by outside tortoise collectors is essential.

Madagascar Bigheaded Turtle, *Erymnochelys madagascariensis* – Madagascar - CR

This evolutionarily and biogeographically remarkable turtle inhabits the west-flowing rivers and floodplain lakes of Madagascar, where it is under severe pressure from harvest for local consumption. Only two small populations inhabit protected areas. Survey data document an ongoing decline. Durrell Wildlife Conservation Trust's program to protect the species, re-introduce headstarted animals, and engage local communities at several sites in Madagascar, quietly implemented by native conservationist Juliette Veloso, needs substantial increases in resources and intensity.

Magdalena River Turtle, *Podocnemis lewyana* – Colombia – EN (CR)

This large river turtle is restricted to the Rio Magdalena basin of Colombia, an area difficult to visit and more difficult to implement conservation actions. However, in recent years, Colombian researchers like Vivian Páez and Mario Vargas-Ramirez have developed applied research and conservation programs focusing on both the conservation biology of the species and addressing social challenges of the local communities partly dependent on the species for their subsistence needs. These programs can and should be increased very substantially. Their analyses have also recently recommended the elevation of IUCN Red List status for this species to CR.

Palawan Pond Turtle, *Siebenrockiella leytensis* – Philippines – CR

Rediscovered in the past 10 years after being a mystery species for most of the 80+ years since its description, this freshwater turtle species endemic to the Philippine island of Palawan faces the twin threats of harvest for local consumption as well as being in great demand in the illegal global pet trade. After initial surveys of Palawan by Philippine and foreign researchers we now have a decent understanding of the species' distribution and status, and it is legally protected. However, the next phase of identifying the locations of best populations and working to ensure these populations and their habitats are effectively protected in the long term is needed. Sabine Schoppe of the local Katala Foundation has become deeply involved in Philippine and regional turtle trade analysis and conservation actions, and is well situated to effect significant progress for this species as well.

Annam Pond Turtle, *Mauremys annamensis* – Viet Nam – CR

The Annam Pond Turtle originally inhabited a variety of lowland wetlands in central Viet Nam; few animals were known to science until large numbers began appearing in the East Asian consumption trade in the 1990s. Nearly extirpated in the wild by collection for trade within years, many animals were diverted into zoos, hobbyist collections and commercial farms, where the species breeds prolifically. Assurance colonies are at a point where they can produce more hatchlings than conservation facilities can house, and captive reproduction is being slowed down for now. Meanwhile, efforts are underway by the Asian turtle Program to safeguard one or more wetlands within the original range for re-introduction, which will represent the first re-introduction program for a Southeast Asian turtle species.

Roti Island Snakeneck Turtle, *Chelodina mccordi* – Indonesia – CR

This is an attractive snake-necked turtle endemic to the tiny island of Roti in southeastern Indonesia. It has an extremely limited distribution and has been subjected to intense collection pressure for the international pet trade

market, which drove it into virtual commercial extinction within 10 years of its recent description as a new species. Recent field surveys by Rhodin, Kuchling and Ibarrondo have documented extremely depleted remaining populations still being impacted by persistent collection efforts, with remaining habitat areas also being reduced by agricultural development and conversion of swamps and marshland to rice fields. No protected areas exist on Roti that include *C. mccordi* habitat.

Priority actions needed to prevent *C. mccordi* from becoming extinct in the wild include 1) identifying candidate protected areas, formally establishing these, and providing adequate on-the-ground infrastructure (a previously proposed area, Tanjung Pukuwatu on the Tapuafu Peninsula, provides significant potential for critical habitat protection for some remnant turtle populations); 2) Improved control of persistent illegal trade, through increased awareness and enforcement capacity of wildlife officials in Roti as well as at domestic airports.

Bog Turtle, *Glyptemys muhlenbergii* – USA – EN, pending CR

The Bog Turtle has lost the great majority of its suitable habitat in historic and recent times, and has suffered further impact from past collection for the pet trade, fragmentation and degradation of remaining habitats, and possibly roadkill and increased predation rates; while emergence of epidemic disease, and climatic change, are recent developments of unknown but potentially severe future impact. Detailed quantitative range-wide estimates are not available, but overall reduction is likely to have exceeded 80% of habitat and 90% of individuals over the course of the 20th century, with declines stabilized in many but not all sites at present, and only localized population increases. Due to the species' highly fragmented occurrence in habitats subject to vegetational succession, intensive management is needed to retain existing populations; creation of alternative sites is challenging; and the species' low reproductive output (on average under 4 eggs/year per mature female) and relatively late maturity (about 6 years) means recovery is a slow gradual process at best.

Flattened Musk Turtle, *Sternotherus depressus* – Alabama, USA – VU, pending CR

Sternotherus depressus inhabits a limited range in a single drainage system in Alabama. Its habitat has been under severe impact from pollution and sedimentation from nearby open coalmining, and impoundment of stream sections. Diseases has impacted the species and animals are in some demand for the pet trade. Surviving populations occupy about 7% of historically suitable habitat, and remain at lower abundance than 20 years previously. Generation time is unknown but likely to be over 20 years. Much of the historical impact has ceased or been brought under tighter regulation, but while the remaining populations have mostly stabilized, population recovery to pre-impact levels has not been documented. It can be argued that the species has lost about 90% of total habitat and associated populations in its past two generations, and while causes of reduction have largely ceased, they are not clearly reversible, and population recovery to historical levels is unlikely in the future two generations if present trends and processes continue. Priority conservation measures are to restart the FWS Recovery Plan process and designate Critical Habitat under the Endangered Species Act.

North American Desert Species: *Gopherus agassizii* (pending EN), *Gopherus flavomarginatus* (VU, to be re-assessed), *Terrapene coahuila* (EN), *Trachemys nebulosa* (NE), *Trachemys taylori* (EN), *Trachemys yaquia* (VU), *Kinosternon sonoriense longifemorale* (subspecies EN or CR).

The deserts of the southern United States and northern Mexico have over time gained a remarkable collection of tortoise and freshwater species that are endemic to specific desert oasis systems, desert rivers, and particular ecozones. The most recent known turtle extinction occurred here: the Big-headed roughfooted mud turtle (*Kinosternon hirtipes megacephalum*) from Viesca, Coahuila, disappeared sometime between the collection of some museum specimens in the 1960s and its description in 1981. These deserts, and particularly the water sources in the Mojave, Sonora, Sinaloa and Chihuahua Desert Wilderness regions are under progressive threat. These threats are predominantly in the form of habitat conversion, either direct through expansion of irrigated agriculture, renewable power generation infrastructure, and residential developments, as well as indirectly through groundwater pumping, river damming and diversion, and the effects of narcotrafficking and border security. Climate change, specifically altered rainfall patterns, is likely to hit these regions hard. While several protected areas and biosphere reserves exist, recent history has shown that these protective statuses do not safeguard from military and energy generating absorption of public lands, while groundwater and climatic changes are pervasive and difficult to manage or mitigate.

Priority actions in this context are more general and exploratory for this region than the hands-on actions for the preceding species. They include further research on trends, impacts and appropriate conservation measures for North American desert ecosystems, and specifically how turtles are affected and can be safeguarded. These measures will

likely include set-aside wilderness areas inviolate from development and infrastructure, improved protection of waterbodies and holistic, sustainable water and agricultural management practices, as well as maintaining assurance colonies for turtle populations under acute threat.

Thematic priority projects for Tortoises and Freshwater Turtles

In addition to targeted conservation actions for priority turtle species, a number of thematic projects are of strategic importance for comprehensive turtle conservation:

USA – domestic commercial take

Consistent regulations across States – Inter-state transfer (pets), minimum sizes & closed seasons (snappers, softshells), invasives regulations

Analytical review of medicinal aspects of turtles



Turtle shell fragments offered in a wholesale market as ingredients for Traditional Chinese Medicine, Guangzhou, 2000 and 2006

Consumption of turtles (and in some instance their eggs) have purported medicinal effects in a variety of traditional and folk medicines and customs. These range from alleged cancer-curing properties of a jellied essence from the Golden Coin Boxturtle (*Cuora trifasciata*) and the use of powdered turtleshell bone in Traditional Chinese Medicine (TCM) through claimed increased athletic performance properties of blood from Chinese Softshells (*Pelodiscus sinensis*), and increased human sexual prowess from consumption of turtle eggs, to the use of tortoises in ‘muthi’, witchcraft practices in southern Africa.

Few of these claims have been objectively evaluated through pharmacological studies, and where pharmacological effects from turtle products have been documented, these have not been evaluated for efficiency in comparison to alternatives. For example, the mineral selenium is a component of turtle shell and selenium has anti-cancer properties, but whether a selenium tablet from a pharmacy is any less effective than ground turtle bone remains unstudied.

What is needed is a comprehensive review of the purported medicinal uses of turtles and turtle parts, including a thorough review of scientific-pharmacological research of compounds derived from turtles, and a gap analysis to identify follow-up research topics to link disparate studies and perceptions into a foundation for objective understanding of the possible pharmacological value of turtles, engagement of the pharmaceutical industry to ensure that drug development does not amplify, direct or indirect, exploitation pressures on wild turtle populations, and outreach to the general public about the values and fallacies of turtle consumption for medicinal purposes.

Climate Change and Tortoises and Freshwater Turtles –

Climate change is a widely accepted concept that will greatly affect the spatial and seasonal patterns of temperature and rainfall of areas where turtles occur. Climate change has the potential to affect turtle populations significantly. At a particular site, population numbers may increase or decrease depending on habitat and ecological developments, while turtle population structure may change as a consequence of environmental sex determination (ESD); ESD is a characteristic of many turtle species, by which eggs incubating at relatively warm temperatures develop into female turtle hatchlings, while relatively cool eggs yield male turtles. At a spatial scale, climate change may make some areas no longer inhabitable to particular turtle species, while other areas may become suitable as turtle habitat; over time, turtle species' distribution ranges may expand, contract or shift. Such distribution changes are known for some species after the last ice age, and modeling and predicting future ranges of various turtle species under different climate change scenarios will not only be scientifically interesting, but is also of great significance when designing connectivity into networks of protected areas. Climate modeling studies for turtle distribution are of particular interest for the United States, Mexico and southern Africa, but are also desirable for Asia, Australia and at global level.

Turtles and human land use



Srinagarind Dam, Thailand



Box turtle besides road, Virginia, May 2010

Tortoises and freshwater turtles do not necessarily need to live in wilderness areas unaffected by human impacts; many species are quite tolerant of moderate human habitat alteration, and some actually thrive in man-made habitats such as irrigation and stormwater canals, traditional small-scale field and cropland systems, and parks and other recreational lands [so-called socio-ecological production landscapes under the '*Satoyama*' initiative]. In contrast, some turtle species are specific in their ecological requirements and are restricted to particular habitat types that are impacted or destroyed because the soil and other conditions are perfect for a particular type of agriculture. A specific case is the Geometric Tortoise, ecologically restricted to the Renosterveld of South Africa, a heath-type vegetation whose underlying soil is perfect for vineyards; 98% of the species' former habitat has been lost to agriculture, and the Geometric Tortoise does not persist in agricultural landscapes. Even turtle species who in principle can adapt to human alteration of the general landscape may well be impacted by particular components of the landscape, particularly roads and other infrastructure.

A global overview is desirable of which turtle species thrive in human-managed landscapes, and how such landscapes can be adapted and optimized for the persistence of tortoises and freshwater turtles and their ecological

associates. Also needed is an overview of turtle species and populations which are at increased risk from current and planned agricultural and infrastructure development projects, particularly in a context of economic development and climate change, and possible options for mitigation. Cases for consideration range from Mojave Desert Tortoises being impacted by solar energy generation, through impacts of groundwater extraction on wetland systems inhabited by narrow-range endemic freshwater turtle species in Mexico, to impacts on riverine turtles by hydroelectric dams and water diversion schemes, and ongoing expansion of road networks and residential areas.

Invasive species and invasive turtles



Chinese Softshell Turtles, farmed in China, offered in a supermarket in Virginia, USA, July 2008

Invasive species issues are one of the leading causes of biodiversity loss, and tortoises and freshwater turtles play a role on both sides of the issue. Many turtle populations and species are severely impacted, directly or indirectly, by the intentional or accidental introduction of alien invasive species into their range; obvious cases are the Galapagos tortoises, impacted by goats who eat their habitat and rats who eat their eggs and hatchlings, invasive fire ants destroying turtle nests and hatchlings in much of the southern United States, or invasive vegetation replacing turtles' preferred foodplants, choking waterways and smothering nesting sites. Human presence and habitat alteration can also upset the ecological dynamics between native species, usually with negative results for turtles: natural predators 'subsidized' by human actions and infrastructure, such as raccoons maintaining large populations by surviving through winter on human-provided food and trash, or ravens colonizing desert areas thanks to electric poles providing safe nesting sites, can maintain large populations and exert a severe predatory impact on turtle populations.

Conversely, a few turtle species are widely transported and released into the wild by humans, where they may impact local species and ecosystems by hybridizing with native turtle populations, competing for food or basking sites with native turtles, and preying on sensitive native species of animals and plants.

Review papers on impacts of non-native / invasive turtle species on native turtles and native ecosystems, and on impacts of introduced and subsidized species on native turtles are urgently needed, including considerations of priority research topics and recommendations to minimize current and future impacts. .

Freshwater Turtle mortality in commercial and recreational fisheries –

Mortality through drowning in commercial fishing gear like nets, fykes and traps, and intentional killing of turtles caught in commercial or recreational fisheries because they are perceived as fish predators or competitors, remains rampant in many parts of the world. Drowning in pots set for blue crabs in the Chesapeake Bay is now considered the most severe impact on Diamondback Terrapins (*Malaclemys terrapin*) populations, and turtle bycatch is known to be extensive (and lethal) in inland waters of the US MidWest.

An overview of mitigation measures and fishing gear modifications that have been developed in different fisheries is highly desirable, as is a mechanism to distribute this knowledge to fishery operators and regulators, and establishment of a communications forum where experiences and ideas can be exchanged and deliberated.

Ecosystem role and benefits of turtles

While it is evident to many that threatened species and populations of tortoises and freshwater turtles are entitled to conservation actions for reasons of threatened status, charisma or resource management mandates, turtle conservation also helps turtles maintain their ecological roles. While the academic sector has qualified the ecological characteristics of turtles to varying extent, there is no clear comprehensive survey of the direct and indirect ecosystem benefits provided by tortoises and freshwater turtles from which humans benefit. These benefits are assumed to include plant seed dispersal, vegetation management, control of insect and snail populations, keeping water clean by scavenging dead animals, and keeping populations of food fish healthy by eliminating weak and unhealthy individuals. Overall, turtles are likely to be of net benefit to humans even if not used as protein for consumption, though the significance of turtle-mediated ecosystem benefits remains unquantified. While the contributions of turtles to human wellbeing are difficult to define and more difficult to quantify, it will be helpful to overall conservation, and particularly helpful to include turtles in overall conservation strategies, if a thorough overview of the ecosystem values of turtles were available.

Top 25 Turtles on Death Row

SNAPSHOTS OF THE WORLD'S TOP 25 MOST ENDANGERED TURTLES—2003



River terrapin
Batagur baska
S.E. Asia (Indo-Burma &
Sundaland Hotspots)
Hugh Quinn, Cleveland
Metroparks Zoo



Vietnam leaf turtle
Mauremys annamensis
Vietnam (Indo-Burma
Hotspot)
Rick Reed, Fort Worth Zoo



Western swamp turtle
Pseudemys marmorata
Australia (Southwestern
Australia Hotspot)
Gerald Kuchling



Striped narrow-headed softshell
turtle
Chitra chitra
S.E. Asia (Indo-Burma
Hotspot)
Chris Tabaka, DVM



Southern speckled padloper
tortoise
Homopus signatus cafer
South Africa (Succulent Karoo
Hotspot)
Thomas F. J. Leuteritz



Mary river turtle
Emydura macrura
Australia
John Caren



Roi snake-necked turtle
Chelodina mccordi
Southern Indonesia (Wallacea
Hotspot)
R. Andrew Odum, Toledo
Zoological Society



Yangtze giant softshell turtle
Rafetus swinhoei
China and Vietnam
Ha Dinh Duc



Dahl's toad-headed turtle
Batrachemys dahl
Colombia
Russell A. Mittermeier,
Conservation International



Chinese three-striped box turtle
Cuora trifasciata
Northern Vietnam & China (Indo-
Burma Hotspot)
Kurt Buhlmann, Conservation
International



Madagascar big-headed turtle
Erymnochelys madagascariensis
Madagascar (Madagascar and
Indian Ocean Islands Hotspot)
Gerald Kuchling



Abingdon Island tortoise
(Galapagos tortoise)
Geochelone nigra abingdoni
Galapagos Islands (Chico-Darien-
Western Ecuador Hotspot)
Anders G. J. Rhodin, Chelonian
Research Foundation



Arakan forest turtle
Heosemys depressa
Myanmar (Indo-Burma
Hotspot)
James E. Barry



Ploughshare tortoise
Geochelone yaghoora
Madagascar (Madagascar
and Indian Ocean Islands
Hotspot)
Thomas F. J. Leuteritz



Central American river turtle
Dermatemys mawii
Central America (Mesoamerica
Hotspot)
John Polisar



Burmese star tortoise
Geochelone platynota
Myanmar (Indo-Burma
Hotspot)
Chris Tabaka, DVM



Flat-tailed tortoise
Pyxis planicauda
Madagascar (Madagascar and
Indian Ocean Islands Hotspot)
John L. Behler, Wildlife
Conservation Society



Bog turtle
Clemmys muhlenbergii
United States
Roger Barbour



Sulawesi forest turtle
Leucocephalon yuwonoi
Indonesia (Wallacea Hotspot)
Chris Tabaka, DVM



Geometric tortoise
Psammobates geometricus
South Africa (Cape Floristic
Region Hotspot)
Thomas F. J. Leuteritz



Yellow-blotched map turtle
Graptemys flavimaculata
United States
David E. Collins



Painted terrapin
Callagur borneoensis
S.E. Asia (Indo-Burma &
Sundaland Hotspots)
Rick Reed, Fort Worth Zoo



Philippine forest turtle
Heosemys leytensis
Philippine Islands
Walter W. Timmermann, ETI
World Biodiversity Database



Burmese roofed turtle
Kachuga trivittata
Myanmar (Indo-Burma
Hotspot)
Gerald Kuchling



Egyptian tortoise
Testudo kleinmanni
S.E. Mediterranean
(Mediterranean Basin Hotspot)
Omar Attum

This list of the world's top 25 most endangered tortoises and freshwater turtles was compiled by the Turtle Conservation Fund (TCF)—a partnership of the Center for Applied Biodiversity Science (CABS) at Conservation International (CI), The World Conservation Union Species Survival Commission's (IUCN/SSC) Tortoise and Freshwater Turtle Specialist Group (TFTSG), and IUCN/SSC Turtle Survival Alliance (TSA).

IMAGES AVAILABLE UPON REQUEST