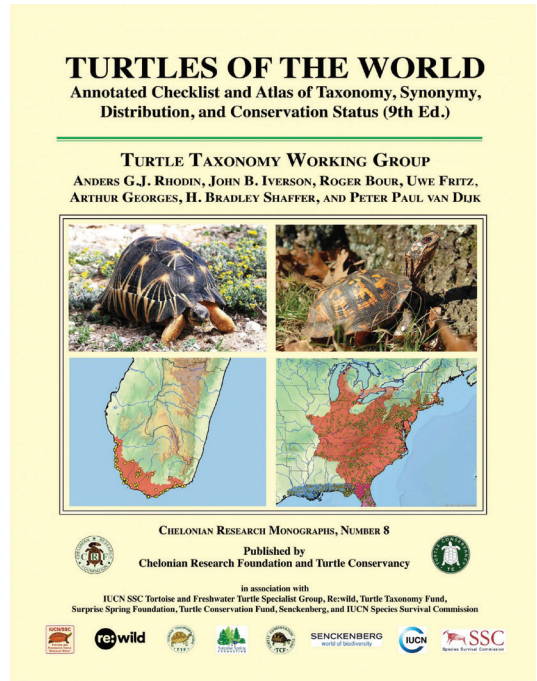


Turtle Taxonomy Working Group (Rhodin, A. G. K., J. B. Iverson, R. Bour, U. Fritz, A. Georges, and H. B. Shaffer). 2021. **Turtles of the World Annotated Checklist and Atlas of Taxonomy, Synonymy, Distribution, and Conservation Status** (9th Ed.). *Chelonian Research Monographs* 8: 1–472. DOI:10.3854/crm.8.checklist.atlas.v9.2021.

Turtles are among the smallest of vertebrate groups in terms of modern diversity, but they are also among the most endangered. More than half, 51% to 56% of taxa are considered threatened or endangered by various government and international agencies. Some 10 modern species group taxa (species or subspecies) out of 486, have become extinct since 1500 CE. Advancement of study and conservation of all members of this group requires that an up-to-date, well organized, and thoroughly researched checklist of nomenclature is easily available to all turtle biologists. The Turtle Taxonomy Working Group (TTWG) has labored for the last four years on a revision of the previous checklist (TTWG 2017). The 9th edition of the work is a detailed and complex volume that easily accessed for free and will greatly facilitate the efforts of all chelonologists.

The members of the Order Testudines are ancient survivors, with a fossil history spanning back to the Triassic, some 230 million years. They have survived two mass extinctions, one at the end of the Triassic (the great dying), and a second at the end of the Cretaceous (KT boundary). Their survival through periods during which some 80% of all life went extinct is testament to their survival abilities. Their ecological role as mostly omnivorous, thoroughly armored generalists, may have helped, although some are highly specialized. They have diversified many times in their long history and are one of the few living vertebrate groups in which the number of described fossil taxa greatly outnumbers the living ones. Living turtles are clearly the product of hundreds of millions of



years of evolution, a treasure trove of living fossils.

The 9th edition of the Turtles of the World Checklist is a well presented, logically ordered volume presenting all the essential baseline information for every species and subspecies of turtle in the world. The Introduction begins with the statistics of the volume, number of taxa, percent at risk etc. Then moves on to a detailed methodology. This methodology explains how this volume was brought together, discussing nomenclatural changes and how they were derived, and new additions to this edition such as type specimens and body size. Included here are the guidelines the authors followed for introducing a taxonomic or nomenclatural change. Further they discuss how the species distributions and maps were developed. All of this is essential to a stable Checklist, one that will be used and followed. By explaining the methodology, they demonstrate the thoroughness and hence authority of the Checklist.

This 9th edition of the Checklist has been dedicated to two giants of turtle research, Peter C. H. Pritchard and Roger Bour, both of whom sadly passed away recently. Their contributions to turtle biology were vast and they were mentors to many current turtle biologists including myself. It is noteworthy that they have been honored together.

The 9th Edition of the TTWG Turtles of the World Annotated Checklist consists of accounts for all species and subspecies of turtles that have existed since 1500 CE with this cutoff deemed modern turtles. Species are treated in taxonomic groups that reveal current understanding of higher turtle relationships. Each account includes, the nomenclatural history, distribution and conservation status of the species. Numerous photographs have been added in this edition, including many important diagnostic views of plastral, carapace and head morphology, of each taxon where possible. There are tables of new taxa added since the 8th edition and names that have been synonymized, and useful discussions of the working groups methodologies and positions on several issues in nomenclature. Other important discussions on genetic pollution were also presented; it is extremely risky to release turtles of unknown origin, even into their home range. Of prime importance is the appendix of annotations (TTWG 2021:356-376), an essential part of any checklist, which adds explanation of every nomenclatural and taxonomic decision made throughout the work. This edition includes annotations from previous editions of the checklist (TTWG 2021:377-407), which are provided for relevant taxa in this volume. It is encouraged for all users of this work to read the annotations, particularly if you disagree with any of the nomenclature in the current volume.

It is important to recognize that this checklist is a synthesis of all available taxonomic and nomenclatural information that carefully conforms to the ICZN Code of nomenclature. The product of this synthesis is the generally accepted nomenclature for the community of

biologists that works with and uses the presented taxonomy and nomenclature (Garnett *et al.* 2020). This community, in this case chelonologists of any discipline, has a say in what is the accepted classification as discussed by Krell (2021). It is therefore prudent to examine this work in terms of the principles laid out in Garnett *et al.* (2020) and their subsequent papers for the development of Global Lists. As such one of the main principles was to aim for community acceptance, although not everyone will agree with every decision, this work does in general present the most widely accepted classification and taxonomy of turtles.

Another point discussed by the Global Species List Working Group (GSLWG) of the International Union of Biological Sciences (IUBS) is that checklists must be transparent. Checklist development is not a black box and it is important to document how specific decisions were made. This is the value of the annotations and the inclusion of a detailed methodology in the checklist reviewed here. It is clear for every taxon how any taxonomic decision has been reached. The dilemma faced by the authors is that it is important to have stability, but same time this must be balanced against timeliness and academic freedom. Hence names are changed judiciously to promote stability, but are changed to maintain currency if the evidence is clear (Garnett *et al.* 2020). In an effort to meet requirements of traceability, all editions of the checklist are available together online, and the annotations from all editions are included in this 9th edition.

One criticism offered about the 8th edition of the checklist from 2017, was that it offered options in highly contentious taxa. This is not the purpose of a checklist and creates instability. As such it is good to see this problem corrected in the 9th edition. A checklist is not a taxonomic or nomenclatural work per se; it is a synthesis of previous works that seeks to provide a stable classification framework. The 8th edition (TTWG, 2017) addressed these issues in annotations but did not present a single name for each taxon. An

example of this is the generic group names for certain American pond turtles, in listed as “*Emys...* or *Actinemys...*” (TTWG 2017:75). This is confusing and can lead to instability. In the 9th edition the authors have taken a better path this set of species in the genus *Actinemys* (TTWG 2021:171) with pointers to the annotations for a discussion of the issues. Stability in taxonomy is a primary purpose of checklists such as this one and this improvement in the 9th edition addresses this important issue.

A particularly useful and desirable feature of the Checklist is the highly detailed maps. These maps are for species level but show both the estimated distribution and the confirmed distribution by the presence of vouchers. These vouchers represent either museum specimens or published locality accounts for the species. For those species with subspecies the map uses color coding of the distribution to differentiate these. The *Testudo graeca* complex is an excellent example of this (TTWG 2017:297). Distribution maps can be utilized by many specialists for a large variety of reasons and are particularly necessary in Taxonomy, Conservation and Management.

Another important discussion point is a strong suggestion to researchers who are considering nomenclatural changes. They are advised to take care to carefully follow the ICZN rule changes for electronic publication (ICZN 2012) and ensure that the journal, if not print on paper, is properly registered with ZooBank and archived accordingly.

The acknowledgements of the 9th edition are large and pay tribute to the many turtle specialists that provided information, distribution information and photographs of the species they specialize in, myself included. I will acknowledge that I was consulted on a number of the species from the family Chelidae. Garnett *et al.* (2020) are clear that this is an important factor in the GSLWG assessments of checklists, as it is important that all people involved in checklist development are given credit for their contributions. This encourages further

collaboration, stability and usage of the volume. In the case of this 9th edition, I note specifically that Peter Uetz was acknowledged and this is valuable as he heads the Reptile Database, the preeminent Reptile Checklist of the world of which turtles are of course a part. It is important for stability that these major checklists are in communication. Other checklists and global entities using this checklist include Wikimedia Foundation (Wikipedia and Wikispecies), Catalogue of Life and many Government entities and NGO’s in a variety of countries.

I would be remiss not to applaud the authors and publishers for the way this volume is made available. It can be purchased as a hardbound copy for US\$49.00 but more importantly can be downloaded in Pdf form for free from the website (<https://iucn-tftsg.org/checklist/>) as can all previous versions. This makes this important volume available to anyone, particularly students in countries where the prohibitive cost of text books prevents them ever seeing them. Much of the supporting literature can also be obtained in pdf form from <https://iucn-tftsg.org/taxonomic-literature-database/>.

Without doubt for anyone working on turtles, or thinking about doing so, this is one of the major volumes they will need. The species-specific information is invaluable and the literature cited will give you lists of the pdfs to obtain. Furthermore, the emphasis on careful documentation of taxonomic decision and adherence to the principles of the ICZN Code of nomenclature provide excellent guidance from the thoroughly experienced group of turtle researchers.

References

- Garnett S.T., L. Christidis, S. Conix, M. J. Costello, F. E. Zachos, O. S. Bánki *et al.* 2020. Principles for creating a single authoritative list of the world’s species. *PLoS Biol* 18(7): e3000736. <https://doi.org/10.1371/journal.pbio.3000736>.
- ICZN. 2012. Amendment of Articles 8, 9, 10, 21 and 78 of the International Code of Zoological Nomenclature to expand and refine methods of publication. *Zootaxa* 3450: 1–7.

Krell, F.-T. 2021. Suppressing works of contemporary authors using the Code's publication requirements is neither easy nor advisable. *Bulletin of Zoological Nomenclature* 78: 61–67. <http://dx.doi.org/10.21805/bzn.v78.a02>.

TTWG [Rhodin, A. G. J., J. B. Iverson, R. Bour, U. Fritz, A. Georges, H. B. Shaffer, and P. P. van Dijk]. 2017. Turtles of the World: Annotated Checklist and Atlas of Taxonomy, Synonymy, Distribution, and Conservation Status. (8th Ed.). *Chelonian Research Monographs* 7: 1–292. DOI: 10.3854/crm.7.checklist.atlas.v8.2017.

TTWG (Rhodin, A. G. K., J. B. Iverson, R. Bour, U. Fritz, A. Georges, and H. B. Shaffer) 2021. Turtles of the World Annotated Checklist and Atlas of Taxonomy, Synonymy, Distribution, and Conservation Status (9th Ed.). *Chelonian Research Monographs* 8: 1–472. DOI:10.3854/crm.8.checklist.atlas.v9.2021.

Scott A. Thomson

Centro de Estudos dos Quelônios da Amazônia
- CEQUA, Manaus, Brazil.

Secretary, IUBS Global Species Lists Working
Group.

E-mail: scott.thomson321@gmail.com.